N A V Y

Proposal Submission

The responsibility for the implementation, administration and management of the Navy SBIR program is with the Office of the Chief of Naval Research. The Navy SBIR Program Manager is Mr. Vincent D. Schaper. Inquiries of a general nature may be brought to the Navy SBIR Program Manager's attention and should be addressed to:

Office of the Chief of Naval Research
ATTN: Mr. Vincent D. Schaper
Navy SBIR Program Manager
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SBIR proposals shall not be submitted to the above address and must be received by the cognizant activities listed on the following pages in order to be considered during the selection process.

The Navy's mission is to maintain the freedom of the open seas. To that end the Navy employs and maintains air, land and ocean going vehicles and personnel necessary to accomplish this mission. The topics on the following pages provide a portion of the problems encountered by the Navy in order to fulfill its mission.

The Navy has identified 106 technical topics in this DOD Solicitation to which small R&D businesses may respond. While this will not impact funds of Phase awards that result from the topics listed in this solicitation, it makes it extremely important that Phase award recipients influence the end uses of the technology since Phase II SBIR funds will be limited and thus highly competitive.

Selection of proposals for funding is based upon technical merit and the evaluation criteria contained in this solicitation document. Because funding is limited the Navy reserves the right to limit the amount of awards funded under any topic and only those proposals considered to be of superior quality will be funded

DEPARTMENT OF THE NAVY
FY1992 TOPIC DESCRIPTIONS

OFFICE OF NAVAL TECHNOLOGY

N92-001 TITLE: Multi-spectral Sensor Fusion System for Identification of Relocatable Targets

CATEGORY: Exploratory Development

OBJECTIVE: To devise a method for fusing multi-spectral/multi-sensor data to obtain identification and localization information on relocatable targets.

DESCRIPTION: A proof concept is sought that demonstrates new methodology for intelligent integration of information form various sensors for cruise missile missions. A hierarchical and adaptive control scheme of multisensor integration systems is desired for improvement of image understanding, correspondence problem, and sensory data fusion. The potential advantages in integrating and/or fusing information from multiple sensors are that the information concerning features that are impossible to perceive with individual sensors can be obtained more accurately, in less time, and at a lesser cost. Data fusion using object-oriented data structure may be achieved by considering simultaneous multiple images of the same scene as well as other intelligent information. Also data on the road nets and local terrain can be stored by giving to limit search area possible off-road locations for relocatable targets. A knowledge-based system can be constructed which would consider the particular description of each primal structure before deciding ho to incorporate it into the final representation of the scene. Heuristics would be based on tentative classifications of structures or on domain-independent knowledge such as those used for single-band imagery.

Phase I: Determine the feasibility of a new methodology to integrate information obtained from various sensors.

Phase II: Based on results of Phase I study, develop proof of concept designs and experimental verification of the proposed methodology.

Phase III: Transition opportunities to the ONT precision strike initiative, and LRCSW exist.

N92-002 TITLE: Virtual Environment Control for Advanced Undersea Manipulators and Unmanned Underwater Vehicles.

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to provide a virtual environment to control underwater manipulators and unmanned underwater vehicles for performing of a large variety of tasks.

DESCRIPTION: Control of unmanned undersea manipulators and submersibles becomes increasingly critical as distances between the system and the human operator increases. In particular, the bandwidth of the control and data link for acoustically controlled systems quickly become limited to regions of hundreds of hertz or less. Maintaining visual and acoustic image data contact with the surrounding environment becomes, therefore, increasingly difficult, even if effective data compression techniques are employed. The purpose of the SBIR investigation is to provide a human operator with a feeling of telepresence with the environment even in conditions where the bandwidth or time delays in the communication link prevent real time television or sonar displays of the remote environment. A virtual would or virtual environment can produce the feeling of a real time presence using low bandwidth updates for positions of objects in the remote environment.

Phase I: Study and design of interaction of virtual environment and low bandwidth feedback signals.

Phase II: Provide full demonstration of virtual environment control concepts.

N92-003 TITLE: Bidirectional Modifiable Synaptic Element for Artificial Neural Networks (ANNs)

CATEGORY: Exploratory Development

OBJECTIVE: Investigation, design and demonstration of novel bidirectional modifiable synaptic functions for highly dense and efficient learning neural networks.

DESCRIPTION: In order to meet present and projected "Smart autonomous weapon/robot" signal handling requirements for surveillance, detection, tracking and delivery of munitions/submunitions, and "in-situ learning" VLSI chip that emulates both the propagation of patterns through (and modifications of weights in) a neural network (NN) is under development in various research centers within the Department of Defense, industry and academia. To achieve a desired connectivity in density (10^{11} connections) and speed (10^{12} connections/sec) – similar to a bee's brain – with a few analog VLSICs of a neural "system", innovation in algorithms, architecture and design is a prerequisite to a useful, high density, efficient learning and low power NN. Bidirectional interconnection weights would facilitate efficient implementation of a number of NN paradigms, ANNs offer promise as highly efficient analog computers in a number of application areas of interest to the Navy/DoD; e.g., sensor interpretation for pattern recognition; image (target) recognition; associative computer memory and control; and radar and sonar signal processing and preprocessing. Although ANNs are presently in a phase of hardware implementation, the result falls extremely short from the potential of compactness speed and truly parallelism for real time application; e.g., the Intel ETANN has the capability of 104 interconnects (storage) and 10^{10} interconnects/sec while the human brain, where a significant minority of the interconnections between neurons are electrotonic (resistive and bidirectional in nature), is estimated at 10^{14} - 10^{16} interconnects/sec. Where a significant minority of the interconnecting between neurons are electronic (resistive and bidirectional in nature), bidirectional weights could allow simplified hardware implementation of such a network again by duplexing feedforward and feedback signals through the same weight matrix.

Phase I: Address (a) theory and concept of a bidirectional modifiable synaptic function for compact implementation with sufficient parallelism to still allow for real time applications; and (b) implementation and demonstration (in analog silicon VLSI) of the optimum synaptic function: the design should be scalable to achieve 10^{11} interconnects and 10^{12} interconnects/sec for target recognition using multidimensional inputs.

Phase II: The effort will explore the practical implementation into a large multiarray comprising at least 106 synapses per array, followed by a feasibility demonstration illustrating the approach to achieve I(b), above.

N92-004 TITLE: Superconductor Transformaer and Inductor Lead Interface connection Technology

CATEGORY: Exploratory Development

OBJECTIVE: The objective is to make maximum effective use of superconduction devices and to find a practical way to utilize their highly attractive characteristics with minimum complexity.

DESCRIPTION: High temperature superconductor materials are metallic oxides in the form of solid matrix similar to ceramics. Silver has been used extensively as the interconnecting material, however silver does not bond well to the superconductor material and may well conduct too much heat into the superconductor and thereby cause it to transition into the normal state, rather than remaining in the superconducting state. The result could destroy the superconducting device. A better interface connection material is urgently needed.

Phase I: Search for best possible electrical, mechanical, thermal, and chemically stable connection materials to provide circuit connection between superconductors and normal room temperature circuits.

Phase II: Demonstrate feasibility of method.

N92-005 TITLE: Organic and Organic-Ceramic Composite materials for Optical Memory, Switching and Light Modulation

CATEGORY: Exploratory Development

OBJECTIVE: Develop organic materials or composites of organic materials including ceramics for optical memory, switching and modulation.

DESCRIPTION: There is a need to develop organic, ceramic or composite materials capable of optical memory, modulation and switching, The material should be responsive in the wavelength region between 850mm to 1.5 micrometers. The switching time should be optimized with a goal of submicroseconds. Choice of materials should be optimized to operate in severe military environments. Potential applications may include replacement for rotating switch, crossbar switch, waveguide switching and optical neurons and optical computing. The Naval Surface Warfare Center, has in-house capability to test these materials and encourages small businesses that are not equipped with optical diagnostics.

Phase I: A study showing the material is a stable memory or switch and has possibility to survive in a military environment.

Phase II: A prototype device meeting military specifications will be produced.

N92-006 TITLE: Dynamic Holographic Nonlinear Optical Materials

CATEGORY: Exploratory Development

OBJECTIVE: Develop new materials which are capable of sustaining dynamic (real-time) holographic phase gratings.

DESCRIPTION: There is a need to develop fast, sensitive and efficient dynamic holographic nonlinear optical materials for applications such as all-optical beam steering, beam deflection, phase image storage, optical implementation of parallel processing, all-optical associative type memory, reconfigurable optical interconnections, non-reciprocal energy transfer and beam amplification, and phase conjunction. The materials for these applications shall be capable of containing phase holograms (phase gratings) which are indeed (written) by incident optical interference patterns (spatially varying incident light) and are required to be erasable, for example, by flooding the medium with uniform light. These materials may be organic, inorganic or a hybrid configuration, and are required to have a wavelength response in the visible and near-infrared spectral region, compatible with existing low power laser beams. Response times to optical excitation are required to be milliseconds or less. The Naval Surface Warfare Center has an optical diagnostic facility capable of observing and evaluating important material parameters required for photonics and opto-electronics research, and will assist contract awardee in determining relevant parameters produced during this effort.

Phase I: Deliver a prototype material meeting the above requirements.

Phase II: Optimization of both the growth and synthesis techniques and relevant material characteristics of optical materials meeting the above requirements.

N92-007 TITLE: Growth of Large Beta Silicon Carbide (SiC) single Crystals

CATEGORY: Exploratory Development

OBJECTIVE: Growth of large Bata SiC single crystals for high-power and high-frequency devices.

DESCRIPTION: Beta silicon carbide (β-SiC) possesses a unique combination of properties important for high power device applications, epically for high frequency devices. The combination of its wide bandgap, high saturated

electron drift velocity, high breakdown electric field, low dielectric constant and high thermal conductivity give it a figure of merit of r high power microwave applications that is 1100 times better than that of Silicon (Si) and 183 times better than that of GaAs. The most common polytype of SiC, designated 6H-SiC, has similar properties but, because of its lower electron mobility, has figure of merit which is 700 times greater than Si for high power microwave devices. Modeling of 6H-SiC MESFETs using empirical values show that these devices will output 75 W at 10 GHz (0.5 um gate length) and, based on its higher mobility values, β-SiC should gie significantly higher power output. The power density value for 6H-SiC is about 5 times higher power output. The power density value for 6H-SiC is about 5 time higher than that obtained for state of the art Si or GaAs devices of similar dimensions. Currently, there is no source of large single crystals (boules) of β-SiC from which to make wafers. It is herein proposed to grow boules of β-SiC, suitable for use as substrates for epitaxial growth of β-SiC thin films.

Phase I: Identify growth concept and estimate characteristics.

Phase II: Optimize and demonstrate feasibility of method.

N92-008 TITLE: Improved Electrochemical Test System for Evaluating Disbondment of Organic Coatings.

CATEGORY: Exploratory Development

OBJECTIVE: To fabricate and demonstrate and improved portable, non-destructive instrument based on Electrochemical Impedance Spectroscopy (EIS) for use in objectively evaluating subfilm coating disbondment on coated metal surface, such as ship hulls and tanks, long before surface evidence of coating deterioration is apparent.

DESCRIPTION: The vendor/manufacturer will demonstrate an improved EIS system with a design centered around lap-top sized personal computer technology.

Phase I: An EIS system will be designed specifically at evaluating organic coatings on metal surfaces in field environments. An in-house demonstration of the bread boarded system measurement capabilities to 10^{12} ohms at 10^{-3} Hz with an input signal of ≤ 10 mv a-c will be conducted.

Phase II: The second phase will be focus on the delivery of two prototype units to the David Taylor Research Center (DTRC), including documentation for field usage.

N92-009 TITLE: Signal Representation for System Identification

CATEGORY: Exploratory Development

OBJECTIVE: Design, develop, and evaluate innovative algorithms which operate on signals to reveal features which parameterize nonstationarity, nonlinearity, and statistical properties of the systems radiating those signals.

DESCRIPTION: New technologies such as large scale integration electronic chips and neural nets have gained some success in application to automatic recognition of undersea acoustic, electromagnetic, and communication signals represented by standard spectrograms. However, large false alarm rates, coupled with the need for automatic alertment in multichannel systems, requires new signal spaces which go beyond the usual liner models of time/frequency distributions and wavelets. This SBIR task seeks innovative approaches which yield multidimensional measurements related to system linearity and stationarity as well as statistical properties.

Phase I: Develop the algorithms.

Phase II: Evaluate applications of these algorithms using real data from operational systems.

N92-010 TITLE: Shallow Water Mine Countermeasures.

CATEGORY: Exploratory Development

OBJECTIVE: Identify innovative techniques and technologies required in the detection, classification, identification, neutralization and clearance of mines and minefields in water depths from 80 feet to the high water mark.

DESCRIPTION: Technologies may include any innovative mix of acoustic, electromagnetic, electro-optic, explosive and non-explosive techniques. Concepts should emphasize high payoff for rapid reconnaissance and wide-area clearance, as well as near-term (1995-2000) and far-term (2000-2010) applications.

Phase I: Identify potential concept, means of deployment and cost per system for countermeasure missions. Quantify capabilities of each concept.

Phase II: Demonstrate optimum concept(s) from Phase I study, showing performance objective is achievable and capable of being deployed from existing Fleet Assets.

N92-011 TITLE: Noncontact Measurement Techniques for surface Stress Distrbution

CATEGORY: Exploratory Development

OBJECTIVE: To develop a measurement technique, associated equipment and procedures which can be used to map out the surface stress distribution on complex naval structures using noncontact techniques.

DESCRIPTION: In the structural design, evaluation, and monitoring of naval ship structures improved methods to measure surface stresses are required. Contact methods of measuring surface strains often require surface preparation of the structure that may not b desirable in the case of organic composites or access the location may be difficult. Comparison of analytically predicted strains with contact measurements frequently allows only point by point comparisons. Capabilities required for the new method are: (1) noncontact measurement of surface stresses; (2) scan and record stress field due to static and dynamic loads; and (3) produce color stress contour lots, which can be compared to finite element analyses.

Phase I will evaluate candidate technologies which have the potential of meeting the objective and are suitable for testing naval structures.

Phase II should develop the selected technology and prototype equipment and should demonstrate the applicability of the technique on representative naval structures in shipyard, shipboard and laboratory environments.

N92-012 TITLE: Standardized Teleremote Kit for Marine Corps Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop a standardized remote control (Line Of Sight/Fiber Optics) system which uses off-the-shelf components and can be easily programmed/adapted to all Marine Corps vehicles.

DESCRIPTION: This solicitation attempts to take advantage of robotics technology related to robotics control architectures, actuators, autonomous vehicles, data compression, flexible linkages and automation for remote control operations of Marine Corp vehicles.

The envisioned concepts may replace classical “man-in-the-loop” operations and concurrently provide a system that is easily attached to all Marine Corps vehicles and can significantly reduce the exposure of Marine Corps personnel during hazardous operations. Devices used to remotely control various Marine Corps vehicles are extremely limited and lack any degree of standardization. The advantages of a standardized remote control unit/system are: and

increased ability to utilize any remote control system on any Marine Corps Vehicle, flexibility in providing necessary remote control operation to the Fleet Marine Force (FMF), and ease of adaptation/installation of the remote control systems.

The primary mission of the Remote Control System is Remote Control (LOS/NON LOS) operation of all Marine Corps vehicles. It's secondary capability would be the standardization of remote control architectures and components to reduce duplicity.

Phase I would consist of concept exploration resulting in a feasibility study, review of current documentation, and a preliminary design study which produces a System Concept Document (SCD), or equivalent. The SCD or equivalent must describe the proposed hardware design to include materials, proposed remote control architecture, actuators, data compression, frequencies, flexible linkages, tactical employment, storage and use, flexibility, size and weight estimates.

Phase II would consist of preparation of detailed design drawings and assembly of the prototype devices. Prototype design will be verified by remote operational testing for effectiveness using Marine Corps vehicles.

N92-013 TITLE: Rechargeable Batteries

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop a "family" of rechargeable batteries to power military vehicles, radios, computers, and other military/commercial electrical devices.

DESCRIPTION: This solicitation attempts to take advantage of new materials technology related to rechargeable batteries for military applications. By having a rechargeable battery that can be molded/cut into the various shapes, the unused space found in vehicles, computers, radios, and other battery-powered devices could be utilized to pack more electrical energy on board that equipment than is currently possible With improved battery performance, field units can sustain their electrical devices over a greater period of time with less logistical support. Research is not limited to polymer technology.

Desired characteristics are as follows:

- Rechargeable life of at least 1500 cycles.
- Reduced weight by 80% of current battery
- Charge retention of 300% of current battery
- Shaped, cut, molded into conventional and nonconventional shapes
- Operating temperature range of 30 to 140 degrees F.
- Ruggedized to minimize power loss from punctures, such as bullet holes.

Phase I should include, as a minimum, tow prototype batteries of different size, but do not have to be to exact form/fit of the battery being replaced. Contractor should demonstrate by analysis that all of the above characteristics can be achieved by the selected technology for a wide range of batteries for military applications. Limited testing should be performed and documented to verify the design of the two prototype batteries.

Phase II would be the design and development of a designated group of batteries in exact form/fit for test and evaluation.

N92-014 TITLE: Retractable Mechanical Suspension for Tracked Vehicle

CATEGORY: Exploratory Development

OBJECTIVE: This effort will be directed at the development of feasibility designs to show packaging, layout, system requirement, weight, and volume requirements for the given system.

DESCRIPTION: Future amphibious and non-amphibious track laying combat vehicles can benefit from a suspension system that retracts the roadwheels/track. This will allow the vehicle to reduce its silhouette while on land. While in water, this will allow the track and roadwheels to be brought up flush with the underside of the vehicle to reduce hydrodynamic drag.

Development efforts in the past have centered on complex hydropneumatic and fluidic suspension systems that require transference of fluid to effect retraction. A simple mechanical system that can be operated reliably is desired. It is also highly desired to reduce the length of protrusion into the vehicle hull by the suspension system. Enlarging the mounting face is acceptable (within limits). Technical requirements are: static load of 5000-6000 pounds adjustable, 16 jounce travel, 5 inches rebound travel, damping of up to 6000 pounds, vehicle ground clearance of 16 inches, 3.5 to 4 g load at full jounce. An actuation mechanism is required to enable retraction and extension by driver control. Protrusion into the vehicle of 24 inche4s or less is desired, total diameter of mounting provision should be 24 inches or less. A nominal roadwheel diameter of 24 inches, roadwheel spacing of 30 inches, and a 3 inch thick, 21 inch wide track should be assumed.

During this effort, it is expected that layout drawings and engineering calculations will be generated of the hardware system to demonstrate feasibility and show packaging, layout, system requirement, weight, and volume requirements for the given system.

N92-015 TITLE: Electrical Rotary Motion Actuator

CATEGORY: Exploratory Development

OBJECTIVE: This effort will be directed at the development of feasibility designs to show packaging, layout, system requirement, weight, and volume requirements for the given system.

DESCRIPTION: Future combat vehicles will incorporate appendages that need to be operated and stowed or extended based on vehicle mode of operation (land or water). Current components to actuate these systems are hydraulic rotary actuators that operate at medium to high pressure, but minimal flow. Incorporation of electronic power busses and survivability concerns encourage replacement of hydraulic components with electric components where applicable. This effort is to develop a rotary electric actuator with lockout capability to power and move combat vehicle components.

Technical Requirements are: rotational torque level of 12,000 inch-pounds, 180 degrees of rotation, weight of 50 pounds or less, body diameter (less flangers) of 8 inches or less. Input voltage of 270 VDC is required, and control electronics may be located separately from the actuator, but need to be minimized in size. The actuator shall be capable of positively locking and holding full load at either position with less than 5 degrees slippage. Operation while submerged in saltwater is a requirement. Rotation of the 180 degrees while under full load should be accomplished in less 10 seconds. During this effort, it is expected that layout drawings and engineering calculations will be generated of the hardware system concepts to demonstrate feasibility and show packaging, layout, system requirement, weight, efficiency, and volume requirements for the given system. A non-functioning mock-up that accurately represents all necessary components shall b delivered at completion of the effort.

N92-016 TITLE: In-Arm Drive System for Wheeled and Tracked Vehicles

CATEGORY: Exploratory Development

OBJECTIVE: This effort will be directed at the development of feasibility designs to show packaging, layout, system requirement, efficiency, weight, and volume requirements for the given system.

DESCRIPTION: Future wheeled and tracked vehicles may encompass common components for mobility. A compatible in-arm drive system would allow utilization on either a track laying system where the roadwheel need not be powered, or a wheeled vehicle where power to the hub is selectable. Current tracked vehicles do not use powered wheel hubs, but instead rely on a sprocket to drive the track. Most wheeled vehicles utilize drive shafts and

constant velocity joints to power the wheel through the hub. One drive system that incorporates a roadarm and wheel hub capable of driving a wheeled vehicle or supporting a roadwheel is envisioned. Suspension support is also required in this system.

Technical requirements are: static load of 5000-6000 pounds adjustable, 16 jounce travel, 5 inches rebound travel, damping of up to 6000 pounds, vehicle ground clearance of 16 inches, 3.5 to 4 g load at full jounce. A nominal roadwheel diameter of 24 inches for a tracked vehicle or a pneumatic tire of 36 to 42 inches is envisioned. Drive power in the wheel mode of operation is anticipated at 25 – 50 HP per wheel. Free-wheeling as a roadwheel hub is necessary.

During this effort, it is expected that layout drawings and engineering calculations will be generated of the hardware system concepts to demonstrate feasibility and show packaging, layout, system requirement, weight, efficiency, and volume requirements for the given system.

N92-017 TITLE: Combined Antenna System for Assault Amphibian Use

CATEGORY: Advanced Development

OBJECTIVE: Produce a high performance, multi-band vertical antenna for simultaneous use of multiple spread spectrum transceivers.

DESCRIPTION: Future improvements of Amphibious Assault Vehicles (AAV) call for the use of at least two radio transceivers operating simultaneously in the 30-90 MHz spectrum. Because of limited space on the AAV and the desire to maintain low profile, it is desirable to use a single wide band vertical antenna. The antenna may be a stack of a number of elements in the vertical direction but overall length is limited to twenty (20) feet. The antenna system must provide sufficiently high intra-antenna isolation to allow operation of all transceivers without degradation of receive or transmit capabilities. SWR presented to either transceiver shall be no greater than 3:1 across the specified spectrum.

Each phase will require:

a) an initial brief including a program objective, actions and millstone review,
b) a final review and
c) a brief and final report to the USMC project manager.

Phase I: Investigation and assessment of various options. Selection of appropriate concept. Analysis of selected concept.

Phase II: Design of selected concept will be completed and several prototype systems will be constructed. Testing will be conducted in factory by contractor and by Marine Corps at various Government facilities after installation in AAVs.

SPACE AND NAVAL WARFARE SYSTEMS COMMAND

N92-018 TITLE: Automatic Detection of Acoustic Signals on Lofargrams Using Image Processing Technology

CATEGORY: Exploratory Development

OBJECTIVE: Develop, demonstrate, test, and evaluate multiple dimensional filters for detection and feature extraction algorithms as automatic signal detector and determine the Receiver Operating Characteristics (ROC) curve of each algorithm.

DESCRIPTION: The task is to develop, demonstrate, and measure the applicability of various multiple dimensional filtering algorithms/techniques to the problem of extracting the maximum amount of information from the Full

Spectrum of acoustic radiation, and presenting that information to an acoustic operator in a form which maximized the operator's performance in a highly cluttered environment. It is also required that these algorithms reject biologic activity and profiler activity from the acoustic spectral regions in which they occur while preserving the signals of interest in that spectral region. The measures of algorithmic performance include probability of detection, probability of false alarm, and recognition differential over a fix observation period. Proper spectral preparation of the time series data in frequency time format to the algorithms is required with attention paid to both frequency and time redundancy of the presented data. Real (from the Full Spectrum Database) and simulated data will be supplied by the Navy for demonstrations and testing. Candidate algorithms/techniques are to include: Two dimensional Fourier Transforms, Radon/Hough Transforms, Gabor/Wavelet Transforms, Wigner-Ville, etc.. The use of public domain applications (e.g., NIH's Image with Fourier Transforms) and commercially available applications for signal and image processing is encouraged.

Phase I: Develop as required and implement on a computer critical applications (at least the two dimensional Fourier Transform) for testing with real (provided by the Navy) and simulated time series data. Determine and present the ROC curves for three signal types of interest to the Navy.

Phase II: Perform as directed by the Navy, ROC curve analysis for other signal types an for the other transforms. For Navy selected algorithms/techniques, develop and specify acoustic processing chains and processing functions for implementation on a Navy workstation.

Phase III: Implement the multiple dimensional filtering applications as a complete operable computer program in high level language (C, FORTRAN, Pascal, Ada, etc.) on a Navy workstation (DTC III processor and display) for sea test at an IUSS site during an exercise.

N92-019 TITLE: Global Positioning system (GPS) Top Sounder

CATEGORY: Exploratory Development

OBJECTIVE: Exploit GPS error signals to characterize and gauge the ionosphere for cross-section analysis of HF radar and communication paths.

DESCRIPTION: GPS uses two frequencies to ascertain signal delays passing through the ionosphere. These are measured as errors and used to correct position solutions. Since this process is a means of measuring columns of Total Electronic Content (TEC), multiple top-soundings from the GPS constellation could provide significant detail of the ionospheric pattern and possibly lead to enhancement of predictions for selectable areas and sites.

Phase I: Develop and demonstrate the feasibility of techniques and algorithms to transform propagation delays (errors) into TEC presentation and evaluation.

Phase II: Demonstrate TEC contours on a PC style workstation in real and integrated time, providing high confidence in predicting hour to hour trends.

N92-020 TITLE: Mobile Surveillance System (MSS) Performance; Analytical Capability

CATEGORY: Exploratory Development

OBJECTIVE: Develop the capability to comprehensively analyze the performance of Mobile Surveillance Systems. (MSS).

DESCRIPTION: This topic is to determine the feasibility of exploiting Petri Net technology to analyze the performance of large scale sensor and/or C3 systems. A Prototype will be produced that demonstrates the full capability of the target system using advanced Petri Net methodology. The prototype will have a complete, if not fully detailed, model of a representative MSS, Combat DF. The prototype will be capable of being exercised and

producing output that is representative of the performance of the MSS, but not necessarily to the level of detail required for full-scale system analysis.

Phase I: Develop prototype.

Phase II: A robust system capability will be produced, including a full working model of the MSS. In addition, complete design and implementation plans for Phase III will be supplied.

Phase III: The complete capability will be installed at a suitable site.

N92-021 TITLE: Protocols for DATA/Voice Networking

CATEGORY: Exploratory Development

OBJECTIVE: Develop network protocols which support the exchange of voice and data transmission over a given RF link such that a voice and a data link user can time share the same RF circuit.

DESCRIPTION: Network Protocols are sought that permit the efficient exchange of voice and data over low data rate Navy RF links. The concept is to implement one (or a family of) network protocol(s) which establish(es) the required connectivity and dynamically allocate(s) link capacity for the required voice or data exchange. Network management overhead and response time are to be minimized. This effort will include the development of software for test in the Naval Ocean Systems Center (NOSC San Diego, CA) communication Support System (CSS) test facility.

N92-022 TITLE: SHF SATCOM Networking

CATEGORY: Exploratory Development

OBJECTIVE: Develop, define, and show feasibility of SHF SATCOM multi-access network protocols and control schemes.

DESCRIPTION: In the development of the Navy Copernicus and CSS information management and transfer architectures, SHF SATCOM has gained considerable importance because of the increased performance to be obtained for SHF over UHF. The lightweight SHF SATCOM terminals the Navy is seeking to develop will operate in the FDMA and CDMA modes of the DSCS satellite Channel 2. These terminals will provide ship to ship and ship to shore connectivity at data rates from 2.4 to 63kbps. SHF compatible multi-access protocols and network control schemes are required to support exchange of voice, data and image information. Net management overhead and response time are to be minimized.

Phase I: Demonstrate feasibility of network protocols.

N92-023 TITLE: Anti-Surface Warfare Tactical Decision Aid

CATEGORY: Advanced Development

OBJECTIVE: Provide a comprehensive decision support system within the Navy Tactical Command System – Afloat (NTCS-A) to assist in planning and monitoring the ship or battle group Anti-Surface Warfare (ASUW) mission

DESCRIPTION: The purpose of this development is to create a full scale Decision Support System (DSS) capable of providing a complete range of support functions for ASUW missions. The DSS should operate on all NTCS-A configurations, have the capability of taking automatic data inputs, and provide the user with a full range of mission related decision support. The system must be fully integrated with the NTCS-A system including man-machine

interface, database and communication functions. Mission support functions will include, but not be limited to, mission planning for surveillance suing multiple sensors, mission planning for war at sea engagements, battle damage assessment, communication planning, underway replenishment planning readiness assessment and casualty reconfiguration for minimum mission degradation. The system functions must be fully integrated.

Phase I: Produce a prototype on a Navy standard Desktop Computer – 2 that demonstrates the full functionality of the target system. The prototype will be capable of being exercised and producing output that is representative of the desired performance, but not necessarily to the level of detail required for the final full scale system.

Phase II: Produce a robust system capability that contains all of the functionality ready for at sea evaluations under realistic conditions complete design and implementation plans for Phase III will be supplied.

N92-024 TITLE: Acoustic Communication From Integrated Undersea Surveillance System (IUSS) to Naval Forces

CATEGORY: Advanced Development

OBJECTIVE: Demonstrate the application of acoustic communications systems concepts to provide improved tactical connectivity for Anti-Submarine Warfare (ASW) forces.

DESCRIPTION: Improved acoustic communications techniques are required to provide survivable and enduring ASW communications. This project will examine the potential for application of acoustic communications to IUSS as an alternate path for ASW users. Each phase will require an initial brief including program objectives, actions and a milestone review; a final review and brief; and a final report.

Phase I: Analysis should include an operational concept and a system design for integration of acoustic communications to ASW platforms, systems and sensors. The plan will include a survey of existing and planned IUSS/Fleet resources IUSS system/subsystem improvements, acoustic conditions and environmental parameters/issues will be addressed. The feasibility of the proposed system concept must be demonstrated.

Phase II: Encompass modeling, development, laboratory testing, validation and demonstration of the utility of the design concepts. It is anticipated that successful Phase II contractors will transition their technology into the Surveillance Direction System Research and Development Program.

N92-025 TITLE: Optical Technology for Towed Acoustic Arrays

CATEGORY: Exploratory Development

OBJECTIVE: To develop and demonstrate a feasible concept for a very long, low noise towed array which makes maximum use of low power optic technology.

DESCRIPTION: See Phase I and II below:

Phase I: A design concept description for an optic line array, including optic/acoustic sensors, telemetry, shape sensing and power scheme.

Phase II: A laboratory or lake test to demonstrate the feasibility of the key technology components. Successful Phase II design concept will be considered for implementation in an advanced development model for at sea testing.

N92-026 TITLE: Performance Modeling for Automatic DAMA Control

CATEGORY: Exploratory Development

OBJECTIVE: Develop Computer models to analyze the expected performance of the DAMA control channels to perform Automatic DAMA Slot Management.

DESCRIPTION: Since the DAMA slot process can be complex, it is important to understand the delays, set up times, queue management strategies, pending request management strategies, and channel overload strategies for a range of expected circumstances. The DAMA system is used to share access to shipboard UHF satellite communication resources. Users are allowed access to DAMA by written directive. Dynamic assignment abilities are being developed to better utilize the DAMA resources. The DAMA control channels (the CCOW and RCCOW channels) may have inadequate capacity to handle all cases of this dynamic management.

Phase I: Describe the exchange of DAMA messages for all types of transactions that the DAMA Automatic Controller supports. Describe the system modeling tools planned and describe the operational scenarios to model.

Phase II: Gather data on DAMA orderwire loading for the expected scenarios, and develop strategies for use of the orderwired to cope with the loading conditions expected.

N92-027 TITLE: Remote Sensing of Meteorological Parameters Using Light Detection and Ranging (LIDAR)

CATEGORY: Exploratory Development

OBJECTIVE: The objective of this effort is to investigate new approaches for the measurement of in-situ meteorological parameters, specifically wind speed and direction, using LIDAR sounding techniques. Atmospheric winds affect a broad range of current and future weapons systems, including the TOMAHAWK and all ballistic missiles. Such measurements are vital in describing and predicting chemical and biologic weapon dispersion within a tactical operational area.

DESCRIPTION: New approaches and innovative ideas are sought for instruments to measure wind speed and direction utilizing advanced LIDAR techniques for remote sensing. The local area measurements of the wind speed and direction are required for the region between the surface and 3 km altitude. The vertical resolution of the measurements should be 100 meters or better. The local wind and wind shear measurements obtained and displayed in real time can significantly improve the data available for planning and carrying out Naval operations, and would be especially valuable for safety of flight. The effort seeks new capabilities for making remote measurements using techniques such as coherent and direction detection Doppler LIDAR, or other new developing approaches, Proposed instruments should be operable in congested areas, with both civilian and military air traffic, and issues such as eye safety, operating lifetime, technician level operation and servicing should be considered. The techniques will be evaluated based upon their potential utility for advanced atmospheric and meteorological sunder instruments.

Phase I: The Phase I effort should provide a design approach for the concept proposed, and definition of the instrument capability based upon calculations of performance. The concept development should include a plan of action which will result in transition of the basic technology into fielded instruments.

Phase II: The Phase II effort would include a performance demonstration which will confirm the accuracy and capability expected form the fielded system.

N92-028 TITLE: Automatic Classification/Sanitization Using an Expert Systems Approach

CATEGORY: Exploratory Development

OBJECTIVE: Research the se of Expert Systems to automatically classify and sanitize sensitive compartmented data to allow the transfer of information to a system or sub-system operating at a lower classification level.

DESCRIPTION: This topic centers on providing an expert system approach to assigning classification to cryptologic raw information, managing the classification of the information while in the host system, and providing

for automatic sanitization when demanded by the system operator. The classification process will be implemented like a spell check feature.

Phase I: Research the nature of the material being processed; the availability of rules for classification and sanitization; the availability, reliability, affordability of Expert Systems and supporting Software to deal with classification and sanitization rules; and investigation of the schema for the Expert System in which the sanitization rules could be trusted to operate; and a description of at least one alternative for implementing the capability.

Phase II: Prototype development and test in a controlled environment. Phase II will provide for the development of production quality modules to insert in existing/planned tactical Cryptologic systems (OUTBOARD, Combat DF, CCSC, CCSS, BGPHES, etc.)

N92-029 TITLE: Data Base Compression/Decompression

CATEGORY: Advanced Development

OBJECTIVE: Develop a minimum data base compression ratio of 12:1 for unique ASCII data elements contained in selected intelligence data bases.

DESCRIPTION: There is a critical need to replicate selected data base files aboard designated afloat systems from a shore-based data based data base system. Deployed cryptologic units initially load a subset of the shore-based data base system based on expected operating area. If/when the operating area changes, e.g., in response to a particular third would scenario, replication of new data base files may be constrained by existing communications pipe-line/throughput. The objective is to incorporate or adapt ongoing research of data compression techniques into data base compression. Compression of intelligence data files is distinct and unique with specialized application. When combined with a data compression front end, the effective compression ratio is essentially multiplied by the data compression ration. The need for this compression capability carries special importance in the intelligence community, however, it has wider applications.

Phase I: Identify and survey existing and ongoing data compression techniques. Perform an analysis of representative intelligence data files to be sent from shore-to-ship. Analyze and synthesize potential data base compression algorithms, transformations, and techniques.

Phase II: Adapt/develop and test data base compression software/system what will satisfy the minimum 12:1 compression ration. Combine with readily available data communications compression software/systems to determine effective compression ratio.

N92-030 TITLE: Video Environmental Product Compression

CATEGORY: Engineering Development

OBJECTIVE: The objective is to test and develop video compression technology which will be suitable for Fleet use with newly developed environmental computer equipment and systems.

DESCRIPTION: Test and evaluation should be expected during all phases in execution of this proposal. Video compression technology suitable for distribution of video and animated environmental products, including but not limited to, imagery and graphic products is urgently needed to support new, higher technology, sensors and weapon systems.

Phase I: Trade-off analysis of existing or modified compression technology.

Phase II: Complete development

N92-031 TITLE: Synthetic Aperture for Surveillance Applications Using a Towed Array

CATEGORY: Exploratory Development

OBJECTIVE: To demonstrate the benefits of synthetic aperture processing in ocean acoustics. Application of this signal processing technique in ASW would provide the opportunity to perform high-resolution sonar processing using existing low-resolution systems. Development of this technology would demonstrate increased capability in signal to noise enhancement and bearing resolution.

DESCRIPTION: Existing implementation of synthetic aperture processing has been in radar application. Implementation has been primarily to enhance radar resolution of stationary targets. The difficulty of applying this technology to ocean acoustics is that the target it not stationary in space or time. As a result of these constraints the synthetic aperture application in ocean acoustics will require a space-time transform.

Phase I: Develop the mathematical implementation to perform synthetic aperture processing for both moving source and target geometries.

Phase II: Implement Phase I with data obtained during the 3X experiment. The 3X data provides a unique truth basis in that a IX configuration can be tested and results validated against the measured high-resolution performance of the 3X system.

N92-032 TITLE: Voice/Data Integration

CATEGORY: Exploratory Development

OBJECTIVE: Develop techniques which permit base band integration of voice and data to support transmission over a common RF network.

DESCRIPTION: Integration of voice and data is one way to achieve a higher efficiency of RF link utilization especially if voice communication is related to a particular data network. The concept is to minimize the required voice bandwidth and to add a control and packet structure to the voice/data flow to permit exchange over existing and new low data rate Navy RF links. This effort will include the development of software for use in the Naval Ocean Systems Center Communication Support System test facility.
Phase I: Demonstrate feasibility of the proposed technique.

N92-033 TITLE: Surveillance System Planning and Resource Allocation

CATEGORY: Advanced Development

OBJECTIVE: Many operating modes are provided in modern long-range sonar systems. The objective is to assist supervisors in selecting system modes and parameters which best allocate system resources. The development is needed to support currently planned fixed and mobile surveillance systems.

DESCRIPTION: Modern surveillance systems are capable of application to many different environments, target types, and missions. This flexibility of operation in selecting transmits and receive directionality, frequency bands, processing approaches (coherent vs. non-coherent), waveforms, and other parameters confronts a system operator with a bewildering variety of alternative configurations. This task is to develop the concept and implementation plan for an automated sonar system planner to assist operators in selecting surveillance system parameters best suited to the acoustic environment, the mission, a priority target information, and system capability. It is expected that a variety of disciplines including decision theory, numerical analysis, and expert systems may need to be developing surveillance systems and how existing tools for surveillance planning can be profitable integrated into a final system design.

Phase I: Define the required input data and outline an overall allocation procedure.

Phase II: Procedure will be further developed and included as an integral part of ongoing developmental trials, and will include automation of the operator assistance procedures.

N92-034 TITLE: Low Cost HEMP Hardening Approach for Navy Sites/Stations

CATEGORY: Advanced Development

OBJECTIVE: Develop a low cost HEMP hardening approach for Navy sites/stations.

DESCRIPTION: HEMP hardening of existing Navy sites is necessary to protect mission critical C3I operations capability. For maintenance and personnel training purposes, the approach should be one of creating standardized/modular hardware for new and existing facilities.

Phase I: Shall consist of the HEMP event and required safety margin. A standardized listing for C3I systems requiring HEMP protection shall be compiled. Also consist of developing and demonstrating through empirical analysis, a standardized ECP which would provide the desired level of HEMP hardened protection for the identified site/station common C3I systems.

Phase II: Provide a detailed design for Navy facility using techniques proposed in Phase I. The preliminary design will incorporate current DOD guidance on HEMP requirements.

N92-035 TITLE: Modulated Pulse Laser Radar Systems

CATEGORY: Research

OBJECTIVE: By modulating the optical pulse of laser radar at microwave frequencies, many of the techniques used to improve performance of microwave radars can be applied to optical systems. This is particularly useful for underwater applications, where the optical carrier will propagate but the microwave will not. These techniques include, but are not limited to, FM detection, chirping, monopulse compression, and Doppler.

DESCRIPTION: The use of modulated pulses would increase the effective duty cycle of the laser. This has several direct systems benefits. The peak power required would be reduced, and the average power could be increased commensurately. For systems that have limited power available, a longer pulse would permit the use of doubled solid-state laser diodes.

Other possible advantages include motion detection which is not possible in water using coherent optical techniques. Pulse compression techniques could result in systems with higher spatial resolution than with direct short pulse detection. The use of existing models would allow a concise and definitive comparison of various modulation techniques within the limits of the SBIR budget. To data no one has applied microwave techniques to non-coherent optical radars. The possible high payoff of such an approach warrants investment by the Navy to document expected performance.

Phase I: Propagating various pulse shapes through a water model that includes spatial and temporal pulse stretching effects. The resulting performance of such approaches can be compared to the modeling results using un-modified short pulses.

Phase II: Laboratory measurements of promising modeling predications. This would occur only if the results of Phase I indicated sufficient possible Navy utility. Phase III would follow successful laboratory demonstration, if results indicated utility for a Navy applications.

N92-036 TITLE: Real Time, CRT Computer Based Training Package Creation

CATEGORY: Exploratory Development

OBJECTIVE: To develop new concepts for embedded training aids for the IUSS which will allow creation of on the job training using real data as those data are processed.

DESCRIPTION: The Integrated Undersea Surveillance System consists of hardware and software for the purpose of detecting, locating, classifying, and reporting on surface and sub surface targets. This process is labor intensive in all its phases. The operators on which it depends are currently trained in a classroom by watch personnel who would otherwise be operating in the system. The Space and Naval Warfare Systems Command requests proposals to develop and imbed real time, computer based training package creations in the IUSS. This will allow on the job training using real data as those data are processed. The real time, computer based training package creation should substantially reduce oversight by previously trained operators in creating, administering and documenting on the job training.

Phase I: A concept review and cost benefits study.

Phase II: Automation concepts will be implemented, installed and tested as a Naval Facility.

N92-037 TITLE: Display Devices and Techniques to Minimize Fatigue

CATEGORY: Engineering Development

OBJECTIVE: Develop techniques and electronic devices which minimize fatigue in IUSS operators. Develop a figure of merit which allows quantitative measurement of fatigue levels for these operators.

DESCRIPTION: Ocean Technologists currently examine paper copies of Lofargrams to identify and classify lines from threat and non-threat targets. These displays are more difficult to interpret than text. It is expected that future workstations will use an electronic rather than paper display for analysis of these Lofargrams. However, current electronic displays such as cathode ray tubes lead to excessive operator fatigue after several hours.

Phase I: The Space and Naval Warfare Systems Command requests proposals to determine the best form of electronic display for Ocean Technologists. The display must have adequate resolution in time, frequency and amplitude, display and adequate amount of data and be economically feasible.

Phase II: Involve construction of a prototype workstation and demonstration with real data at a Naval Facility. These techniques and technology will have applications in other warfare areas.

NAVAL SEA SYSTEMS COMMAND

N92-038 TITLE: Integrated Logistic Support Life Cycle Cost Model

CATEGORY: Exploratory Development

OBJECTIVE: To develop a model that can both estimate system/equipment logistics life cycle costs and perform trade-offs between alternative designs to determine the lowest logistics life cycle cost design alternative.

DESCRIPTION: The actual cost of logistics support is difficult to determine. Considerable attempts have been made to capture this data but they have primarily focused on supply support costs associated with operation and maintaining a system/equipment. The remaining nine ILS elements have received less attention as has the resources required during the acquisition process to design, plan, and implement a system/equipment logistics program. The Navy Program Manager must be able to more accurately define total system/equipment life cycle costs associated with logistics. This is essential for effective planning and budgeting. Additionally, a method to evaluate different

system/equipment designs based on logistics life cycle costs must be developed. The Navy promotes the use of innovative designs that will lessen the logistics burden. One example would be embedded training that will save money in instructional material, student training, instructor time, and training facilities. Often however, these innovative designs are initially more costly. A method to evaluate both the acquisition and operational costs must be developed so that the lower life cycle cost design is selected versus the lower acquisition cost design.

Phase I: Develop an innovative method to estimate total logistics life cycle costs for Navy systems/equipment that also allow for trade-offs to be performed between competing designs that will select the design that has the lowest life cycle logistics costs.

Phase II: Develop a paper model of the concept resulting from Phase I. Demonstrate the model on a Navy test case.

N92-039 TITLE: Next Generation Low Cost Self-Indicating Casualty Dosimeter

CATEGORY: Exploratory Development

OBJECTIVE: To develop and evaluate alternative approaches to an inexpensive dosimetry system for use in radiation casualty situations as a replacement for the existing DT-60/PD system. A new system could save the Navy over $130,000 a year in calibration costs.

DESCRIPTION: The need exists for a casualty dosimeter which can be used to determine personnel dose exposure during potential nuclear conflicts. The dosimeters must be capable of being read without extra equipment such as a mechanical reader or charger. For example a change in color such as in Litmus paper or a change in liquid level in a tube is acceptable. Use of a table to translate the change in the dosimeter to a dose is also acceptable. These types of dosimeters are stored for more than 20 years and must remain stable over a broad range of storage conditions. The price should be less than $2 per dosimeter.

Phase I: Explore and evaluate available technologies based on cost/unit, method of indication, sensitivity, long shelf life stability, and accuracy.

Phase II: Build and test prototype models. Establish production specification.

Phase III: Develop production model for fleet use

N92-040 TITLE: Advanced Gun Barrel Design

CATEGORY: Exploratory Development

OBJECTIVE: Develop an improved gun barrel which is dissipates heat rapidly and is wear resistant.

DESCRIPTION: A need exists for improved gun barrels capable of performing in any high rate of fire gun which require firing sustained bursts with very high projectile velocities. These barrels must be configured to allow quick heat dispersion and withstand frictional wear.

Phase I: Identify current state of the art Powder Metallurgy, composite materials, super alloys, and manufacturing technology areas such as CVD, HIP, etc., which could increase the longevity of high rate of fire gun barrels. Design and analysis will be performed to determine feasibility of selected concepts.

Phase II: Design, fabricate and test prototype barrels, jackets and liners based on Phase I concepts which demonstrate quick heat dissipation, excellent erosion resistance, relatively light weight, and significantly increased barrel life. Analytical tools and diagnostic test fixtures will be utilized to maximize fundamental understanding of advanced gun barrel technology.

N92-041 TITLE: PC Based Computer Model and Simulation

CATEGORY: Exploratory Development

OBJECTIVE: To develop software to compare effectiveness of different Anti-Air Warfare scenarios.

DESCRIPTION: The Navy is interested in developing a PC based computer model and simulation that is capable of evaluating and comparing the mission effectiveness of alternative Anti-Air Warfare (AAW) combat system suites versus various threats to new classes of ships. The current methodology to support suite selection decisions for new and existing ships is based on large scale Monte Carlo simulations that are costly to set up and run, and do not produce timely results. What is needed is a modeling methodology that can be easily run on desktop personal computers, and that will produce numerical and graphical results to support system effectiveness of various hard kill and soft kill AAW systems, and threat effectiveness and characteristics for various known or technologically projected threats. The model should produce an output that can be used by decision makers to evaluate development options related to combat system equipments to be installed on future ship classes or for modernization of existing ship classes.

Phase I: Develop PC-based prototype software and demonstrate the feasibility using the software to evaluate the effectiveness of alternative combat system suites to meet ship mission requirements against various threats. Phase I will include the implementation of the software on personal computers, and proof of concept for the simulation using hypothetical but realistic inputs for ship mission requirements, systems effectiveness and threat systems.

Phase II: Complete the development of the simulation software. Perform detailed analyses, test and validation of the software by comparing the results to actual applications of other more costly and time-consuming simulations.

N92-042 TITLE: Combat System Distributed Operating System

CATEGORY: Exploratory Development

OBJECTIVE: Establish requirements and performance of a distributed operating system to support new ship designs in the year 2000 and beyond.

DESCRIPTION: See Phase I and II below:

Phase I: Provide an evaluation of available commercial distributed operating systems which would have potential application to combat systems citing characteristics and suitability advantages and disadvantages of the most likely candidates.

Phase II: Quantify recommended performance requirements of a combat system distributed operating system, and provide detailed specification guidelines and a model specification meeting Navy guidelines for a combat system distributed operating system.

N92-043 TITLE: Distributed Explosives for Use in Surf Zone Mine Clearance

CATEGORY: Exploratory Development

OBJECTIVE: Develop an effective concept and prototype for rapidly clearing mines from the surf zone using distributed explosives technology which will transition during Phase III to the Amphibious Mine Countermeasures Program.

DESCRIPTION: See Phase I and II below:

Phase I: Conduct analysis of existing documentation on using distributed explosives for clearing mines from the surf zone. Develop an effective concept which must include a full description of the explosives to be used and the means

to deploy the explosives. In addition the concept must be responsive to the Navy's Incentive Munitions policy and minimize volume and weight of the explosives carried aboard ship. Determine testing necessary to quantify distributed explosive size to be effective against threat mines. Deliverables will be: a report on the analysis which clearly defines the concept; and a test plan for verification of deployment method and explosives size requirements during Phase II.

Phase II: Phase IIA: Develop a scale model system prototype for rapid clearance of mines in the surf zone using distributed explosive technology. The deliverables will include a scale model prototype of both the deployment system and the explosive array suitable for in field-testing during Phase IIB.

Phase IIB: Conduct tests to determine distributed explosive size required to be effective against threat mines in the surf zone. Collect data on blast and pressure profiles to show that all miens covered by the distributed explosive would have been neutralized. Deliverables will be a technical report on the tests and a design disclosure for both the distributed explosive and the deployment system. The report will include: blast and pressure profile data sufficient for the government to validate size and effectiveness; recommendations for refinement of the concept which quantifies distributed explosive size, weight and volume, consideration of the Navy's Insensitive Munitions policy; and recommendations for refinement of the deployment method.

N92-044 TITLE: Non-Acoustic Detection of Underwater Objects Near the Sea Surface

CATEGORY: Exploratory Development

OBJECTIVE: Develop innovative non-acoustic concepts to detect and, if successful, to classify and/or localize underwater objects near the sea surface. Objects of interest range in size from mines to underwater vehicles to submarines. Depth of the objects ranges from 150 feet to the sea surface. Speed of the objects is variable. Successful products from this SBIR program will be considered for transition to advanced development programs for surface ships. Applications in ASW, mine warfare and self-defense, particularly in shallow water and regional conflict scenarios, are envisioned.

DESCRIPTION: See Phases I and II below:

Phase I: Develop theoretical predictions and/or analyze experiments performed to date to assess feasibility of the non-acoustic concepts proposed. The following points should be included in the consideration:

- Consider both current and emerging technologies.
- Shipboard requirements: transmitter power, receiver sensitivities and size of sensor/electronics. Assess maturity of current and future technologies to support developing the capabilities for shipboard use.
- Extractable contact information: For current technologies, what can be achieved in detection/classification/localization of contacts? Performance parameters include detection probability, false alarm rate, classification clues, and accuracies in contact bearing/range determination. Where possible, these parameters should be measured as a function of contact size, type, depth and critical environmental parameters. What can evolving technologies achieve?
- Environmental Constraints: address all factors such as sea state, biologic, surface wave scattering, absorption by propagation media, etc. which have impacts on the performance operation of the conceptual system.

Outputs from Phase I are expected to be study reports.

Phase II: If the conceptual studies conducted in Phase I prove promising, Phase II will demonstrate feasibility of the system concept. The details of the demonstration will depend largely on the particular non-acoustic technology proposed and its maturity as assessed in Phase I and on the cost required. The system demonstration may be as simple as that done in a laboratory using models and scaling laws to show potential utility. Or it can be a full-scale demonstration with sea going vessels and objects. If funding permits, additional efforts will be conducted to assess enhancements which will facilitate transition to advanced development systems for demonstration with tactical platforms.

Outputs from Phase II include test plans and reports, system descriptions and transition plans.

N92-045 TITLE: Training for Submarine Desktop Computer

CATEGORY: Exploratory Development

OBJECTIVE: Develop software to train Naval personnel in the use of the Navy Standard Desktop Computer (NSTDTC) System

DESCRIPTION: The Navy Desktop Computer (DTC) is installed on all fleet submarines. The DTC hosts the Submarine Fleet Mission Program Library (SFMPL) and serves as multi-purpose tactical decision aid. Due to the varied and numerous functions performed by the NSDTC system is desirable to provide interactive training that will allow Naval personnel to learn and review the skills needed to operate the NSDTC system.

Phase I: The contractor will review the existing SFMPL for the current submarine DTC, and develop a plan for providing onboard interacting training, which will allow personnel to train themselves on the use of SFMPL software. TO the maximum extent possible, the design must allow the user to train in the use of one program independently of his training on other programs. As a demonstration of the training approach, the contractor will develop training software for the use of the hardware and one SFMPL program.

Phase II: The contractor will implement the plan developed in Phase I, and test the training aid on submarine fleet personnel typical of those who would use it at sea.

N92-046 TITLE: Radar Waveform Classification Using Signal Processing

CATEGORY: Exploratory Development

OBJECTIVE: To develop an advanced, hybrid, signal processing system to perform high-speed detection and classification of sensor emitters.

DESCRIPTION: A new and innovative approach to RF waveform detection and classification of Radar, IO/IR and ESM signals which integrates proven optical signal processing technology with advanced signal classification techniques, such as optically implantable artificial neural network.

Phase I: Develop the theory, concept and specifications for sensor classification systems based on optical processing techniques for spectral analysis and optically implement able artificial neural network or other parallel processing techniques for signal classification. Provide detailed technical report.

Phase II: Design, develop, demonstrate and deliver a working prototype optical signal processing system for sensor detection and classification. The system can be packaged as a transportable optical breadboard in rack mount size subunits, but must be capable of operating on actual radar inputs, not just simulated data.

N92-047 TITLE: Accurate Low Sample Rate Tracking of Highly Maneuvering Targets

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate alternative means for reducing track data rate requirements in multi-function phased array radars using advanced signal processing techniques.

DESCRIPTION: Recent advances in optimal control theory have proven to be effective in improving response characteristics of nonlinear feedback control systems under conditions of plant uncertainty and noise corrupted measurements. The dual problem of estimating the dynamic state vector of a target vehicle which is to a large extent

kinematically constrained by its innate aerodynamic properties and the manner in which it is employed, has not been adequately addressed within the context of these new theoretical developments.

Phase I: Perform a thorough re-examination of the problem of reducing the track data rate burden on a phased array radar implementation and select candidate implementations.

Phase II: Implement selected algorithms for evaluation. For purposes of comparison, this effort is to include an evaluation of data rate requirements for more conventional tracking algorithms such as those based upon Kalman filtering. It is expected that there are numerous military and commercial applications for these techniques.

N92-048 TITLE: General Purpose Hardware Test Set for Rapid Verification of Low Error Rates in Digital Communications and Radar Systems

CATEGORY: Advanced Development

OBJECTIVE: Develop a hardware test set for rapidly verifying low error rate performance of digital communications or radar receivers via importance sampling techniques.

DESCRIPTION: Developing confidence in the ability of a communications or radar receivers to meet a critical error rate requirement often requires testing which directly involves actual receiver hardware. When testing at low error rates this process is often impaired by the large number of trials required. The objective of this effort is to reduce the number of trials required by several orders of magnitude by appropriately altering the underlying noise distribution so the number of errors occurring in a given time interval is increased. Commonly referred to as importance sampling. This technique has been limited in application to analytical studies employing mathematical models rather than actual receiver hardware.

Phase I: Develop methods and criteria for altering noise distributions applied to the error rate testing of modern digital communications or radar receivers as well as the development or specification of instrumentation needed to support testing.

Phase II: Construct and demonstrate an importance sampling test set with representative equipment. Numerous Phase III military and commercial applications are anticipated.

N92-049 TITLE: Radar High Angle Resolution Techniques

CATEGORY: Advanced Development

OBJECTIVE: Develop Radar High Angle Resolution Techniques

DESCRIPTION: Existing radars have difficulty in resolving multiple target which are within one beam width and within the same range cell with similar Dopplers. It is desired to improve the angular resolution of radars.
Phase I: Survey existing resolution techniques and develop baseline scenarios for proposed resolution technique evaluation. Additionally, innovative techniques should be proposed for Phase II development and evaluation.
Phase II: Additional high angle resolution techniques shall be developed and evaluated. Evaluations should be analytical and verified via computer program simulation. The best candidate techniques should be evaluated by equipment implementation. Numerous Phase III military and commercial applications are anticipated.

N92-050 TITLE: Development of Small, High Efficiency Thermoelectric Cooling Devices

CATEGORY: Exploratory Development

OBJECTIVE: The development of better cooling methods for high heat dissipation and temperature sensitive devices in high-density packaging applications.

DESCRIPTION: See Phase I and II below:

Phase I: Analyze existing thermoelectric coolers and possible redesign for use in high-density electronic packing such as surface mount devices. The designs should be suitable for both simple cooling and maintaining device temperature within close tolerance.

Phase II: Fabricate miniature thermoelectric cooling devices and mount in high-density circuit card application to demonstrate the efficacy of the temperature control. The demonstration should include electrical, mechanical, thermal, and any other relevant measurements.

N92-051 TITLE: RAM Plastic Periscope Outer Head

CATEGORY: Advanced Development

OBJECTIVE: Develop RAM plastic periscope outer head for improved RAM capability and combat survivability. Phase III not required.

DESCRIPTION: See Phase I and II below:

Phase I: Develop procedures and processes for incorporating current technology RAM with low cost plastic or elastomers to provide a material system compatible with operational RAM and survivability requirements. Progress and Final Report(s) are required.

Phase II: Provide four operationally configured outer heads for radar absorption and underwater explosion Test and Evaluation. Progress and Final Report(s) are required.

N92-052 TITLE: Low Profile Submarine Antenna Array

CATEGORY: Exploratory Development

OBJECTIVE: Develop a submarine antenna array for both communications and electronic warfare support measures (ESM) that is flush with the waters surface.

DESCRIPTION: See Phase I and II below:

Phase I: Investigate the feasibility of an antenna array for submarine communications and electronic warfare support measures (ESM) systems that is a horizontal disk shaped array, concentric with the search periscope, that rides essentially flush with the water's surface, undetectable by hostile radars. The investigation should cover electrical, hydrodynamic, and mechanical aspects. Output of Phase I will be an engineering report.

Phase II: Construct a feasibility demonstration model (FDM) of the antenna. Test in both static and dynamic water environment to verify transmission, reception, and direction finding characteristics. Output of Phase II is the FDM and associated test report.

N92-053 TITLE: Universal Submarine Electronics Equipment Packaging

CATEGORY: Exploratory Development

OBJECTIVE: To develop a low-cost universal packaging approach for the use of commercial electronics equipment onboard submarines.

DESCRIPTION: As a result of increasing construction costs, the need exists with in the Navy for a low cost alternative to the current installation approach for electronics equipment onboard submarines. Significant expense is normally incurred in efforts to repackage readily available commercial equipment on a case-by-case basis to ensure its survival in the submarine environment. The maintainability of commercial electronics equipment with respect to the shipboard environment, while providing universal application to the wide range of commercial electronics equipment under consideration.

Phase I: Define the range of problems associated with candidate commercial electronics equipment and identify the necessary constraints and requirements for application of a low cost packaging approach.

Phase II: Generate potential low cost packaging approaches, conduct trade-off analyses, generate prototype design and evaluate the prototype design utilizing modeling techniques and prototype hardware as appropriate.

N92-054 TITLE: Light Weight Shipboard Electronic Equipment Enclosures

CATEGORY: Engineering Development

OBJECTIVE: To develop a lightweight environmental electronic equipment enclosure design for general shipboard Combat Systems applicability.

DESCRIPTION: Significant shipboard weight decreases could be achieved by the development of lightweight electronic equipment enclosures for submarine Combat Systems applications. There is a significant potential for the achievement of decreases in the structural weight of current environmental electronic equipment enclosures by application of new materials and construction techniques. Innovative application of materials and construction techniques to the design of shipboard electronic equipment enclosures should lead to the development of lightweight Combat Systems environmental electronic equipment enclosures.

Phase I: Define specific areas for improvement, identify alternative design/construction techniques and analyze/assess potential improvement and feasibility. Assess overall impact on performance cost, size, health & safety factors and any other significant aspect by the postulated alternatives.

Phase II: Evaluate the alternative design/construction areas having high potential/feasibility, generate a prototype design, and evaluate the prototype design utilizing model techniques and prototype hardware as appropriate.

N92-055 TITLE: Tethered Airborne Imaging System

CATEGORY: Advanced Development

OBJECTIVE: Develop a tethered imaging device capable of extending the imaging capability of submarines and surface ships.

DESCRIPTION: See Phase I below:

Phase I: Investigate the feasibility of developing a stable inflatable device deployable from submarine and surface ships capable of carrying an imaging system payload of up to 20 lbs in winds of up to 70 mph without grounding.

N92-056 TITLE: Automated Software Regression Testing, Analysis, and Reporting

CATEGORY: Exploratory Development

OBJECTIVE: Evaluate the application of PMO 411's Data Capture system to automated testing. Identify specific analysis tools and processes and develop supporting software.

DESCRIPTION: See Phase I and II below:

Phase I: Review existing capability of Data Capture System. Evaluate storage requirements, process scenarios, reporting requirements and other aspects of the Data Capture System to support automated regression testing. Address the configuration control of benchmarks. Investigate the effect of operator sequencing and timing on the comparability benchmarks with Development Plan and a tools philosophy. Evaluate the use of the ADA language for development. Prepare cost benefit analysis for the use of Data Capture System in regression testing situation.

Phase II: Develop tool set to support automated regression testing using PMO 411's Data Capture System. Use ADA as the development language unless otherwise authorized. Establish benchmarks for AN/SOO. Validate benchmarks. Test the performance, correctness, completeness and compatibility of tools in the tool set. Prepare design, operation, and maintenance documentation. Establish the Configuration Control Plan and Procedures for tools and benchmark data.

N92-057 TITLE: Accelerated Life Test Development for Determining the Reliability of SSN-21 Hull Coatings

CATEGORY: Exploratory Development

OBJECTIVE: Provide a means of quantifying the expected life of selected hull coating systems for the SSN-21.

DESCRIPTION: As the SSN-21 enters service the reliability of the hull coating system is unknown, and the repair frequency and need for replacement is a major price consideration. A test is needed to provide a means of ranking coating system candidates for life expectancy, providing data on repair frequency for final coating systems, and to provide a means of evaluating coating improvements in future builds and upgrades. The accelerate life test design must take into account all stresses which hull coatings aboard an SSN-21 would experience. The test must be standardized and repeatable over a time frame approaching 15 years, e.g. as new coatings become available the test must be sufficiently robust that data collected in 1995 are comparable to data collected in 2010. In order to be useful the test design should be directed toward life evaluations out to 15 years, with a test length of less than 1.5 years.

Phase I: Develop an accelerated life test design which thoroughly emulates the Fleet stresses the SSN-21 hull coatings will undergo in 15 years of service. Test articles are expected to be approximately 0.5 meters square.

Phase II: Develop a prototype test facility for the life evaluation of hull coatings. Test three candidate-coating articles in a six-month verification effort. Based on these results provide a final accelerated life test design for SSN-21 hull coating evaluation.

N92-058 TITLE: Non-Destructive Bond Evaluation for Submarine Hull Coatings

CATEGORY: Exploratory Development

OBJECTIVE: Develop a prototype device for bond inspection of submarine hull coatings systems.

DESCRIPTION: The SSN-21 submarine uses hull coatings in variety of applications. These coatings are polymeric in nature, bonded to the external hull, and are expected to last through the life of the boat, or at a minimum through a full yard cycle the life of these coatings is determine to a large extent by the quality of the rubber to metal bonds between the coating and hull. To insure the quality of these bonds an inspection technique is required which can scan large surfaces at high rates, identify the location of the quality of debonded sites in real time, and be sufficiently user friendly to be operated effectively by shipyard personnel. Inspection coverage should approach 100, but should be selectable to allow sampling to make the determination of the need for 100% coverage.

Phase I: Conduct a trade study to determine the best non-destructive inspection (NDI) technique(s) for conducting the inspection and provide a notional design of the system which is ruggedized to withstand the shipyard environment.

Phase II: Fabricate and test a prototype NDI system capable of inspecting a 3 square meter area in less than 3 minutes. After prototype fabrication and testing at the laboratory level provide a system design capable of inspecting all coated areas of the SSN-21.

N92-059 TITLE: Innovative Management Concepts for Modal Analysis and Testing

CATEGORY: Exploratory Development

OBJECTIVE: Develop improved procedures for instrumentation installation and data reduction to reduce costs of Navy ship underwater shock testing.

DESCRIPTION: Continuing advances in modal analysis capabilities and decreases in sensor costs has result in the desired for increased usage of gages during shock tests. As a result, NAVY shock tests contribute significant amounts of time and money to gage installation and data reduction. Cost and time saving measures, such as quicker and more efficient calibration and installation procedures as well as less expensive data recording methods, need to be implemented.

Phase I: Conduct concept, feasibility and cost reduction studies of instrumentation installation and data reduction procedures in support of planned full scale surface ship and submarine shock tests as well as underwater explosion vehicle tests. Provide a final report with a summary of findings.

Phase II: Conduct more detailed feasibility studies during actual pretest preparations. Upon Navy approval, pursue integrating the concepts into standard test operations procedures. Deliverables for this phase include, but are not limited to, providing all necessary hardware and support to integrate the approved concepts, such as manufacturing specialized equipment, developing computer software or providing training programs.

N92-060 TITLE: New Methods of Conducting Submarine Maintenance and Repair While Waterborne

CATEGORY: Exploratory Development

OBJECTIVE: Develop new methods of maintaining, repairing, and inspecting submarine systems and components located in free flood areas while the submarine remains waterborne.

DESCRIPTION: Due to increasing intervals between depot level availability, the Navy requires new ways of conducting submarine maintenance, repairs, and inspections which in the past have required the ship to be placed in dry-dock. New methods must meet Navy safety requirements and be within the capabilities of submarine Intermediate Maintenance Activities (IMAs).

Phase I: Phase I of the project should identify new concepts to be used, systems or components the concepts apply to, the relative pay back to be expected over existing methods, technical development risks involved, risks to ship and personnel safety, and a description of the Phase II effort.

Phase II: Phase II would require rule scale prototype development of the actual technology required and demonstration of it in a Navy IMA environment, as well as further development to a final configuration The contractor will be expected to deliver the final procurement specifications and contract CDRL requirements for inclusion in a system procurement solicitation for Phase III.

N92-061 TITLE: New Applications of Underwater Ship Husbandry (USH) Technologies to Submarines

CATEGORY: Exploratory Development

OBJECTIVE: Apply existing technologies of USH to maintaining, repairing, and inspecting submarine systems and components.

DESCRIPTION: Due to increasing intervals between depot level availabilities, the Navy requires new ways of conducting submarine maintenance, repairs and inspections which in the past have required the ship to be placed in dry-dock. New methods must meet Navy safety requirements and be within the capabilities of submarine Intermediate Maintenance Activities (IMAs).

Phase I: Phase I of the project should identify existing USH technologies currently in use on Naval surface ships or commercial ships which can be applied to Naval Submarine systems and components, the submarine systems or components the technology can be applied to, the relative pay back to be expected over existing methods, technical development risks involved, risks to ship and personnel safety, and a description of the Phase II effort.

Phase II: Phase II would require modification of existing technologies as necessary, and subsequent demonstration of it in a Navy IMA environment on submarine systems or components. After adequate demonstration, the contractor will be expected to develop and deliver final procurement specifications and contract CDRL requirements for inclusion in a system procurement solicitation for Phase III.

N92-062 TITLE: Information Resources Management (IRM) Project Manager Tools

CATEGORY: Exploratory Development

OBJECTIVE: Define management techniques and develop automated tools which help government program managers control ADP system design, development, implementation & change processes.

DESCRIPTION: Various unintegrated tools exist which perform separate tasks under the purview of the Project Manager of data systems. The ideal tools and methodology should integrate the ability to establish function requirements, prioritize the requirements in phased development schedules, track development of the product baseline against the requirements, assess product quality and manage changes throughout the system life cycle.
Phase I: Include analyzing candidate methodologies and tools formulating a strategy for management of ADP development projects, integrating off-the-shelf software tools to support the management strategy and establish criteria for tailoring the methodology and tools to the unique requirements of individual ADP development projects. The products of Phase I will be documentation describing the management strategy and prototype tools.
Phase II: Include refining concepts developed in Phase I for an ADP development project selected by the government, implementing the management strategy for the selected project and completing development and integration of the prototype automated tools.

N92-063 TITLE: Submarine System Value Engineering

CATEGORY: Exploratory Development

OBJECTIVE: To develop components, methods, or techniques that reduce the cost of acquiring and operating systems on submarines without compromising performance.

DESCRIPTION: The combat capability of submarines depends on silent operation, high performance electronics, sensitive sensor arrays, and survivable support systems. These systems are inherently complex and expensive. Innovative concepts are sought to reduce the cost of these systems, to simplify their installation, to make them more reliable, or to reduce their crew requirements without significant sacrifices of performance.

Phase I: Determine the feasibility of the proposed savings approach through analysis and supportable cost benefit comparisons.

Phase II: Construct and test a proof of principle demonstrator.

N92-064 TITLE: Towed Array Handling

CATEGORY: Exploratory Development

OBJECTIVE: To reduce complexity, cost, and ship impact of towed sonar array handling systems. Submarines use towed sonar arrays to reduce the influence of noise generated by own ship.

DESCRIPTION: The arrays themselves are long to maintain directivity at very low frequencies. The long tow cables and arrays require complex and expensive reeling machines and stowage drums that consume valuable space aboard ship. Simpler, smaller, less expensive alternatives are required for handling towed arrays on submarines.

Phase I: Provide a detailed functional description of the proposed system and determine its feasibility through design analysis.

Phase II: Construct and test a proof-of-principle demonstrator at a scale suitable for testing with a small boat.

N92-065 TITLE: Composite Materials Applications for Cost Savings

CATEGORY: Exploratory Development

OBJECTIVE: To develop fabrication methods and installation techniques that use composite materials to reduce the cost of structures and components used in submarines.

DESCRIPTION: Composite materials offer potential savings in structural weight but the high performance matrix polymers that meet submarine requirements for low flammability, longevity in sea water, minimal out gassing, and the like are typically quite expensive. Components made of composite materials are sought that reduce the cost of total acquisition, including fabrication, installation aboard ship, testing prior to ship delivery, and maintenance cost through the life cycle.

Phase I: Provide a detailed description of the component proposed, the material system proposed, the fabrication technique applicable to it manufacture and a supportable cost analysis.

Phase II: Construct and test a proof of principle demonstrator.

N92-066 TITLE: Submarine Electronic Power Service

CATEGORY: Exploratory Development

OBJECTIVE: To develop a reliable, sustainable power system to support the strict power continuity requirements of submarine combat systems.

DESCRIPTION: Combat systems on submarines need electrical power support systems that can carry them through supply outages caused by switching between unparalleled AC sources. The existing system that converts AC to DC for dual source auctioneering through diodes is heavy, complex, and expensive. A simpler, lighter, more reliable means of power supply is required. The eventual system must have a capacity of 75 kilowatts and survive outages of 100 milliseconds.

Phase I: Determine the feasibility of the proposed power supply system through analysis and breadboard system design.

Phase II: Construct and test a proof of principle demonstrator with a capacity of 5 to 10 kilowatts.

N92-067 TITLE: Submarine Silencing Techniques

CATEGORY: Exploratory Development

OBJECTIVE: To develop components, methods, or techniques that reduce the cost of limiting the noise emanated by submarines.

DESCRIPTION: Silent operation is a key factor in submarine performance. Resilient machinery mounts, close tolerance machine elements, noise damping, and active noise cancellation being used or studied are expensive in terms of weight, ship volume consumed, acquisition cost, installation effort, and maintenance requirements. Innovative concepts are sought to reduce the cost and ship impact of silencing submarine systems.

Phase I: Determine the feasibility of the proposed silencing technique by comparing its quieting performance with that of existing methods and by providing supportable cost benefit comparisons.

Phase II: Construct and test a proof of principle demonstrator.

N92-068 TITLE: Classroom of the Future

CATEGORY: Exploratory Development

OBJECTIVE: To tailor methodologies and technology of modern personnel training techniques for integration into the aegis training center classroom of the future initiative.

DESCRIPTION: The AEGIS Training Center (ATC) conducts its technical training by conventional methods with limited use of interactive video trainers, videotapes and part task trainers. Training tasks are becoming more complex due to the increasing sophistication and capability of shipboard electronic systems while demographic data predicts that the number and skill level of Navy trainees will decline over the remainder of this decade. Furthermore, it is anticipated that the ATC operating budget and instructor staff will be decreased. The technical training mission is becoming more difficult while resources are being restricted hence there is a challenge on how to do more with less.

The technical work is to determine the effectiveness of current training methods and seek improvements in the following areas, advances in technology of knowledge in training which are more effective than ones currently employed, remediation for students when existing techniques are unsuccessful, requirement that less skilled trainees do not require longer training courses, ways to obtain more productivity from instructors, and teaming of instructors to insure each course is taught by most highly skilled teacher.

Phase I: Produce a plan for improvement of ATC training.

Phase II: Implementation the plan for improvement of ATC training. Phase III transition to implementation of a fully integrated program is likely.

NAVAL SURFACE WARFARE CENTER

N92-069 TITLE: Advanced Computer Code Development for Underwater Explosion Analysis

CATEGORY: Research

OBJECTIVE: Computational Analysis of Underwater Explosions Fluid Structure Interaction. The objective of this SBIR project will be to demonstrate the interaction of underwater explosions with naval structures: examples "coupled" problems in the analysis of fluid structure interaction.

DESCRIPTION: Current capabilities of Continuum Mechanics computer codes fall short of some requirements for practically modeling the interaction of underwater explosions with naval structures. Fundamentally, a code must be capable of analyzing both Fluid Dynamics and Solid/Structural Mechanics behavior in a coupled fashion, since this is a coupled problem. The Fluid Dynamics algorithms must include multiple material, compressible, reactive and multiphase flow capabilities. The Solid/Structural Dynamics algorithms must handle high strain rate, large strain, and strain rate dependant material behavior, in both a Solid Mechanics sense and a Structural Dynamics sense.

An available method for such analyses is the Coupled Eulerian-Lagrangian approach, in which the fluid is fully coupled to a structure. Under development are Arbitrary Lagrangian-Eulerian codes in which the discretization is confined to neither a Lagrangian or Eulerian framework and Boundary Element codes in which material interfaces and other boundaries are discretized in a Lagrangian sense. It is anticipated that an SBIR topic will expand on these ideas or develop newer ones. An example of an undemonstrated technology is the Free-Language or Particle Hydrodynamics method, in which Lagrangian elements or particles are free to move in the flow field, overcoming the most limiting factor of Lagrangian analyses as applied to fluid motions.

The final produce must be available in a high-level standard language source code that is not machine specific. It must be modular in the sense that changes and additions can easily be incorporated. The code must handle three dimensional geometries, but most also be capable of analyzing simpler two-dimensional cases. The code must not be limited to fluid structure interaction problems; it must be versatile enough to handle standard hydro code type analyses: penetrators, shaped charges, etc.

Phase I, as a feasibility study, should demonstrate the applicability of the chosen method to the underwater explosion fluid structure interaction problem.

Phase II will be the development of the technique(s) into a viable and usable product; this includes the generation of full documentation, the integration of user friendly pre and post processor, the validation of the code(s) with benchmark test cases for comparison with data provided by the Navy, and likely the porting of the code(s) to vectorized and/or parallelized machines.

Anticipated Phase II transitions include the adaptation of the chose method to fields outside the underwater explosion arena, including other highly dynamic fluid structure interaction problems: nuclear reactor design, air blast simulation, etc.

N92-070 TITLE: Optical Signal Enhancements for Optical Digital Computing

CATEGORY: Exploratory Development

OBJECTIVE: To develop and provide a passive optical generator for use in an optical digital computer which uses self electro-optic self.

DESCRIPTION: Self electro-optic effect devices (SEEDs) are currently available to control and enhance optical transmissions passing from one optical device to another in optical networks. SEEDs are useful in optical computing networks where they will be used to boost or refresh optical power or to act as efficient optical switching devices. A passive optical element which acts as a generator of a two-dimensional light array form a laser diode is needed for use with SEED(s) in optical digital computing. The generator must work with an optical wavelength of 850 nanometers, be compact in size, and must generate equally spaced light spots of equal optical power.

Phase I: Construct a prototype passive optical generator capable of producing a 6 by 6-light matrix array.

Phase II: Build the compact passive optical generator which produces a 64 x 64 light array for use in a to-be-specified optical computing system.

N92-071 TITLE: Infrared Detector Array on a Silicon Compatible Substrate

CATEGORY: Advanced Development

OBJECTIVE: Fabricate photovoltaic semiconductor infrared detector array of magnesium silicide overlaying silicon.

DESCRIPTION: The substrate at the focus of this project has the following attractive features: Good lattice-match with common narrow-gap semiconductors. Affinity to SI. Recent work reports the successful growth of Si/MgSi. The MgSi fluorite structure is known to promote growth of good epitaxial quality of some narrow gap semiconductors. MgSi is transparent in the IR. The present approach may provide an alternative to other approaches to bridge the lattice constant and thermal expansion gap between Si, the standard electronics material, and common narrow gap semiconductors.

Phase I is a feasibility study of fabricating di-magnesium silicon on top of a silicon wafer. The study will be comprised of exploring the formation of MgSi by deposition of Mg on a clean Si surface. The ensuing silicide layer will be characterized for its epitaxial quality and morphology. If necessary, further anneal treatment will be devised to improved epitaxial quality. Establishing the mechanical endurance of the MgSi layer under thermal recycling between room and liquid nitrogen temperatures.

Phase II of the project will be comprised of deposition of a semiconductor IR detector and a small array of detectors on the silicide and testing the performance and mechanical endurance of the structure under the thermal recycling described above.

N92-072 TITLE: Rapid Data Access Through Optical Processing

CATEGORY: Exploratory Development

OBJECTIVE: Development of a high-density optical information storage material for parallel optical processing systems.

DESCRIPTION: Naval systems must store and access ever increasing amounts of data in target signature libraries which characterize the many targets or false targets encountered by sonar surveillance systems. These data banks must be rapidly accessed to allow the earliest identification of threats. Improved surveillance and signal processing systems of the future will use larger signature libraries and will require parallel optical processing systems to store, access and reference data. Parallel optical processing begins with a addressable memory unit with very high-density storage and very fast access capability. Novel materials which exhibit resolution in microns, can be addressed in nanoseconds, and can be affordably produced are sought. Photo chromic materials suitable for high-density memory units should be tested in the laboratory to characterize their photochemical and photo physical properties for use in an optical processing system.

Phase I: Characterize a suitable photo chromic materials for use in the memory unit of a high density, fast access, parallel addressable optical information system.

Show feasibility of material use based on its performance, its ease of device fabrication, and its suitability of ruse in optical processing.

Phase II: Conduct an engineering analysis of an addressable memory device built of the material shown to be feasible in Phase I. Fabricate and test a breadboard high-density optical memory unit which could be part of a future phased array optical scanning system having nanosecond access time.

N92-073 TITLE: Cost Effective Ingredients for High Performance Underwater Warheads

CATEGORY: Exploratory Development

OBJECTIVE: To develop low cost methods for making a new chemical intermediate called or SF = CCI. This key intermediate can lead to underwater explosives with improved performance and reduced safety hazards.

DESCRIPTION: Compounds are of interest as ingredients of explosives, especially high yield underwater explosives, and pyrotechnic compositions. Recently been used to prepare a number of energetic SF, solids that exhibit improved physical an explosive properties. Other uses for SF can be anticipated, but the overall utility of is limited by its high cost.

The Phase I effort would identify and evaluate novel approaches to the economical synthesis of SF. This effort would demonstrate feasibility and promising procedures would be scaled up to provide quantities of SF to NAVSWC for testing.

Phase II will optimize the scale up and use of the SF intermediate to produce energetic materials which will be supplied NAVSWC for further testing.

In Phase III, sufficient quantities of new improved SF energetic materials will be provided to formulators of underwater explosives for evaluation.

N92-074 TITLE: New, High Pressure Underwater Gauge for Warhead Evaluation

CATEGORY: Exploratory Development

OBJECTIVE: To develop a new underwater pressure gauge for measuring higher shock pressures than can now be measured with piezoelectric gauges.

DESCRIPTION: The piezoelectric gauges currently used for measuring the shock pressure generated by an underwater explosion fail at 10 kbar; the data based on these gauge measurements cannot be extrapolated to the region close to the target where the severe damage occurs. The use of new, high pressure underwater gauge will permit the detailed investigation of phenomena affecting the lethality of underwater warheads, such as the measurement of the loads on a target from bow shocks of shaped charge jets and the study of the reactions occurring the products of an underwater explosion.

The new underwater pressure gauge shall operate in the pressure range of 3 to 250 kbar, with a response time of less than 0.1 microseconds, a recording time of at least 50 microseconds and a desired measurement accuracy of 5%. The sensing area of the gauge should be less than 2 mm in diameter to allow use with curved shock fronts and small explosive charges.

Innovative ideas are sought, however, one possible approach is to mount a ruby crystal on the end of an optical fiber, excite the ruby with a laser, and measure the pressure induced fluorescence shift of the ruby with a spectroscope. The optical fiber serves to conduct the laser beam to the ruby and to return the fluorescence data to the spectroscope. The line shift could be measured with a silicon diode array or a streak camera.

Phase I shall test the feasibility of the concept. A prototype system will be developed to the point where it can produce a pressure vs. time measurement for a shock known to be above 50 kb. This will test probe survival, response time, and recording time. Thermal effects at the probe need not be removed from the pressure vs. time records during Phase I. Proposals for Phase I shall contain probe designs, expected required instrumentation, and a feasibility study on the expected results from a gauge when placed near an immersed 82 mm diameter pentolite sphere. The gauge response is desired at distances of 5, 40, and 100 mm from the surface of the sphere. The corresponding peak pressures are 102, 19, and 6 kbar and the times for the pressure to fall to half of peak are 6, 11, and 19 microseconds.

Phase II shall produce a laboratory instrument. A prototype system built with improvements suggested by Phase I would be subjected to testing by NAVSWC. From these tests, NAVSWC would evaluate and/make suggestions or further improvements. Phase II would result in several pressure probes and instrumentation capable of making underwater pressure measurements for explosive experiments. In Phase II, direct comparisons will be made with standardized results with other gauges. Phase II will include processing of the raw measurements to remove thermal effects at the probe.

N92-075 TITLE: Methodology for Predicting Fragment Induced Damage to Operating Missile Batteries

CATEGORY: Exploratory Development

OBJECTIVE: Develop methodology to predict the change in output from operating missile batteries resulting from warhead fragment impacts.

DESCRIPTION: Methodology shall be developed to predict the failure of an operating missile battery attacked by warhead fragments. Little work has been conducted to determine and understand the damage modes and failure mechanisms on missile batteries due to high velocity fragment impact. The batteries of interest are 27-30 volt dc, chemical action, and single usage, reserve type. Voltage and current vs. time history of the batteries under load after fragment impact is of interest.

Phase I: The effort would involve postulation of the failure mechanisms, a predictive methodology and a general test plan.

Phase II: The effort would involve specific test planning, conduct of the tests and finalization of the model.

N92-076 TITLE: New Generation Vulnerability/Lethality Computational Process

CATEGORY: Exploratory Development

OBJECTIVE: Develop a new, highly integrated, modern vulnerability/lethality computation process.

DESCRIPTION: The vulnerability, lethality and survivability computational process for conventional weapons involves computerized geometric modeling, preparation of vulnerability-specific information such as component Pkh functions, the tracing of shot lines through the geometric models to produce intermediate vulnerability measures, which are then handed over to an end-game code for the generation of kill probabilities. This process is embodied in a number of stand-alone computer programs, which was appropriate for he computer technology of the time. But newer computer technology may allow significant improvements by integrating the process into one seamless computing environment. It may even be possible to eliminate one or more of the intermediate steps in the current process by adopting a new approach to the V/L process itself.

Phase I: This task should explore the possibility of developing a new highly integrated V/L process that will greatly improve the accuracy, efficiency, and ultimately time and cost to evaluate the lethality of new and existing weapon systems.

Phase II: Collect and review current codes and assessment processes, and computer hardware and software options; develop an overall concept and preliminary system design.

N92-077 TITLE: Target Aim Point Selection Based on Optical Processing of Infrared Images

CATEGORY: Exploratory Development

OBJECTIVE: Develop and demonstrate an optical processing system capable of unambiguously recognizing target features of certain temperatures in an infrared image, in real time.

DESCRIPTION: Optical processing systems have been successfully developed for real time correlation of two-dimensional objects. However, all of these correlator systems still have limitations in terms of scale, rotation and distortion invariance, which significantly reduces their potential application in autonomous smart weapon systems. Another formidable problem associated with the use of optical correlators for automatic target recognition is the inability to identify specific features on targets of interest for accurate terminal phase homing. What is needed a new and innovative approach to the design or an optical correlator system capable of inputting an infrared generated scene and extracting and recognizing target features of selected temperature characteristics in the presence of clutter. Phase I should consist of the development of theory and algorithms and an optical architecture concept. Some limited optical bench demonstration of some features of the design is desirable. Phase II should result in the detailed design, test, demonstration and delivery of a work prototype system, including all optics, lasers, input/output interfaces, post processors, and special devices, such as spatial light modulators, assembled on a compact, easily transportable base.

Phase I: Development of theory, algorithms, architecture, and limited Demonstration of key concepts.

Phase II: Design, development, demonstration and delivery of prototype system.

N92-078 TITLE: Nondestructive Evaluation for Ceramic Matrix Composites

CATEGORY: Exploratory Development

OBJECTIVE: Develop the principles, concepts, design, and construction of prototype equipment for the nondestructive evaluation of ceramic matrix composite radomes before and after firing.

DESCRIPTION: Ceramics of suitable dielectric and mechanical properties are used by the navy for radome applications. Ceramics reinforced by non-reacting whiskers and fibers are being developed for improved radome performance. Nondestructive testing techniques are needed to assist process development, parts fabrication, and product verification. Of particular interest are devices that can be transitioned to radome manufacturing facilities at the end of Phase II.

Phase I: Proposer must consider the physical properties of ceramic composites and secure test specimens for proof of concept testing and demonstration in Phase I. Devices that can simultaneously assess multiple properties, microstructure, and defects are sought. Measurement techniques based on optics, microwave, thermography, laser/ultrasound, and other safe, remote sensing approaches are acceptable.

Phase II: Construct and deliver a prototype instrument.

N92-079 TITLE: Measurement of Shipboard Coatings to Prevent Corrosion Failures

CATEGORY: Exploratory Development

OBJECTIVE: To develop a novel, nondestructive method for rapidly predicting coating failure of shipboard equipment in marine environments.

DESCRIPTION: In a corrosive marine environment, polymer and barrier coatings are used to protect exposed aluminum, magnesium, or steel alloy structures or electronic equipment. These coatings must provide corrosion protection over long periods hence damage of them can cause early maintenance problems or even catastrophic failure of structures or equipment. Laboratory coating studies or characterizations can provide estimates of useful life but individual coating effectiveness varies widely due to environmental conditions, coating quality, and processes used in their application. A method of examining organic coatings and paints on ships is needed to

determine if they are beginning to fail. It is envisioned that shipboard inspections would be done periodically and weak coatings would be identified by changing instrument readings.

Phase I: Identify new methods and instrumentation needed to examine coatings. Limited testing of coatings should be reported to show feasibility.

Phase II: Develop the instruments and test procedures to rapidly determine he effectiveness of anti-corrosion coatings on shipboard equipment and structures. Perform shipboard or marine environment tests to determine efficiency of the system and provide confidence in its use.

N92-080 TITLE: Ocean Environment Sensor

CATEGORY: Advanced Development

OBJECTIVE: Development of an ocean environment sensor.

DESCRIPTION: Detailed knowledge of ocean environmental parameters is needed as an input to radar ducting and electro-optical sensor models used to predict the performance of shipboard surveillance systems. A requirement exists for a sensor that provides real time reports of ocean temperature, air temperature, and relative humidity to a surface ship form distances out to the horizon. Additionally the sensor should measure wave slows and provide wave directional information. The sensor may be expandable or employ remote sensing techniques. An expandable sensors should be easily deployable from ships and possibly helicopters, and be able to function for several hours.

Phase I: Conduct a feasibility and design study. Sensor performance requirements will be defined, and a complete system design will be formulated. This will include the sensor package, and in the case of an expendable sensor a deployment mechanism, data transmitter and receiver, and data display and analysis. A critical design review will be conducted and a final report issued.

Phase II: Fabricate and field test units, and define a production design. Preliminary testing will be conducted in a laboratory environment followed by at least two ocean trails. A critical design review will be conducted after each test. A complete system production design will then be finalized and final report issued. Phase III will consist of system production and operational testing.

N92-081 TITLE: Methods for Early Submarine Classification

CATEGORY: Exploratory Development

OBJECTIVE: To find methods for processing active sonar returns which allow earlier classification of submarines.

DESCRIPTION: Recent theoretical advances have been made in identifying the spectral components of the echo return of wide band sonar signals reflecting from submarine like targets. For example, bi spectrum techniques and the Wigner-Ville distribution represents methods to minutely study the acoustic echo spectrum. It is conceivable that this spectrum is mathematically over complete. Experimental studies are needed to determine the vibrational pattern of submarine models versus sonar frequencies from 3-60 ka. Surface vibrations of submarine models of about 2 cm in diameter will be measured and compared to its effect in theoretical acoustic echo predictions.

Phase I: A theoretical analysis of the submarine model acoustic echo spectrum for simple geometric shops which uses the latest techniques in making predictions and displaying vibrational modes. Feasibility of using this analysis with measurements should be demonstrated.

Phase II: The construction and testing of several submarine models and the determination of methods for early classification of submarines.

N92-082 TITLE: Non-Toxic Coating to Replace the Cadmium Coating Used on Naval Fasteners

CATEGORY: Advanced Development

OBJECTIVE: To replace the cadmium plating used on Naval fasteners with a non-toxic coating without degrading corrosion protection or bonding strength.

DESCRIPTION: A replacement coating and its application process for cadmium plating and its chromate wash are desired for fasteners made from low carbon and alloy steels. Cadmium is a toxic metal. Redistribution of cadmium within the environment is not desired. Replacement feature for feature is required; improvement in a feature at the expense of another is not viewed desirable at this time. In addition, instance have been reported with corrosion products bridging electrical gaps and causing significant electrical shorting problems.

Phase I: Address definition of the attributes of the cadmium plating and its chromate wash and select material and process candidates for evaluation and the criteria; including multiple retightening, salt fog, acid salt fog, alternate immersion, salt atmosphere, scratch test.

Phase II: Fabrication and initial evaluation of specimens will be address in Phase II as well as new candidates and processing modifications. Final evaluation of the candidate will be required at facilities at NAVSWC or the equivalent. Upon completion of the evaluations and documentation, independent Phase III transitions to hardware will begin. Cost of the applied coating on an assortment of fasteners is critical criterion.

N92-083 TITLE: Underwater Tactical Data Link

CATEGORY: Exploratory Development

OBJECTIVE: Develop an underwear tactical data link-to-link surface and underwater assets.

DESCRIPTION: An underwater tactical data link with the surface is desired to integrate and fully utilize all Navy assets. This would require a modest bandwidth underwater link with a range of up to a hundred miles. There are various issues such as propagation delay, signal attenuation, and multipath that must be addressed. Candidate technologies for the data link could be acoustic, laser, remote RF to acoustic buoy or any other viable technique.

Phase I: Determine operational characteristics of the data link and the best technique. Problem areas would be identified and several methods of implementation will be studied. A final report will document all work and choose the most feasible technology.

Phase II: Implement the best technology from Phase I to construct and test a prototype. The final report should contain design analysis and details, complete specification, and test results and evaluation.

N92-084 TITLE: Specification Tree for Federal, Military and Industrial Standards

CATEGORY: Exploratory Development

OBJECTIVE: To develop a software tool and methodology to monitor changes in specifications and drawings.

DESCRIPTION: Changes in specifications and drawing are not easily monitored by non-developing or non-controlling users.

Phase I: Define the needs for and attributes of a multilevel flow chart tool suitable for tracking macro changes in Federal, Military, and Industrial standards, such as termination, cancellation, succession, for assemblies through major combat or warfare systems. Phase I would also provide a working model.

Phase II: Determine computer requirements necessary for the hierarchical flow of interrelationships between the specifications and drawings, as well as direct access to the individual specification. A very user-friendly tool is needed to limit training time and to encourage updating and use. Phase II will also address the need for the ability to monitor individual changes, such as notices for the covered specifications. Phase II will provide a software tool and documentation capable of flowing through five levels of both drawings and specifications, as well as implementing global search and replace features. Phase III would consist of marketing software and documentation to individual users.

N92-085 TITLE: Identification of Critical Design Components of a Real Time Complex Distributed System

CATEGORY: Exploratory Development

OBJECTIVE: To develop pan expert system/simulation that will identify critical components using the criteria of reliability, cost, fault tolerance, and performance in a proposed design of a distributed system.

DESCRIPTION: With the development of real time distributed systems in Navy weapons systems, a need has arisen to determine quickly whether a proposed architectural design encompassing both the hardware and the software will meet the design specifications of the system. The tasks will be to develop an expert system incorporating a rapid prototyping of the proposed designs for simulation purposes to aid in determining if the proposed design meets the specifications. The specifications could involve reliability constraints on both the hardware and the software/ performance considerations in regards to throughput, message handling, error recovery; and cost considerations. The user will be able to enter in these constraints and performance specifications as well as a proposed system design and an anticipated operating environment. The expert system will then, using both its knowledge base and simulation capabilities, determine critical components of the system . If the potential problems are identified, the expert system may provide possible alternative designs to meet the specifications. The system will be flexible enough to allow various measurements to be selected by the user from menus and/or define additional ones as needed. This expert system will be PC based either in a DOS environment or a MAC OS environment.

Anticipated users are any of the Navy sponsors involved in complex systems development. Applications are for command and control, weapons systems allocation, fire control, etc. Any system that is both heavily hardware and software based and where timing considerations for information sharing and processing is vital will benefit from this task. Benefits will result from cost savings, more reliable systems, and higher performance.

NAVAL UNDERWATER SYSTEMS CENTER

N92-086 TITLE: Multistatic Active Sonar: Contact Associated and Data Fusion

CATEGORY: Exploratory Development

OBJECTIVE: To develop automation for associating data and estimating the parameters of Multi-Static Sonar (MMS) contact when the active transmission source is at a significant distance from the receiver.

DESCRIPTION: This automation must work in the presence of clutter, false returns, and other interference and must eliminate as much of the interference as possible. The MSS system consists of a low frequency high power source and multiple receive ships. The SBIR effort shall address only MSS information processing for a single ship; however, MSS contact information obtained from consorts shall be processed with own ship data. The issues include: associating contact returns from different type transmissions; associating returns from a contact which has been lost and re-acquired; associating MSS contact information from consorts, utilizing all MSS information available to provide the best estimates of contact characteristics; eliminating false contacts, and clutter; and eliminating contact ambiguities.

The system developed under the SBIR effort will be required to process data recorded at sea, using an exo-byte tape recorder, and to interface to the MSS information processor, which was developed in “C” and runs on a SUN workstation. Measures of effectiveness and methods of testing are important to the overall effort

The offeror must possess a SECRET clearance.

Phase I: Identify applicable automation; recommend methods for implementation; develop measures of effectiveness; determine methods for testing; plan for integration into MSS Information processing; and demonstrate the automation in the laboratory.

Phase II: Develop the system to operate in real-time, using recorded data and at sea, in parallel with the MSS information processing system.

Phase III: The Navy would recommend to commercial supplier(s) of MSS information processing systems the incorporation of a successful automation technique.

N92-087 TITLE: Energy Absorptive Resin Materials for Undersea Structure Radiated Noise Reduction

CATEGORY: Exploratory Development

OBJECTIVE: To develop energy absorptive structural resins for the fabrication of strong, stiff, and lightweight hull structures, propulsors, and isolation mount foundations, all of which are required to be acoustically inefficient structures.

DESCRIPTION: Advances in energy absorptive resin materials for composite structures are required to reduce the amount of acoustic energy transmitted to the seawater medium by excited underwater structures. Present state of the art involves that application of free or constrained layer damping materials to vibrating structures. The use of such additive treatments entails the penalty of reduced available volume and buoyancy.

Energy absorptive resin systems could be used to advantage in many variant forms. Highly damped structural resins could be used in composite material wet winding, resin transfer molding, and injection molding. Similar technology focused on syntactic foam materials could provide volume efficient, lightweight core materials suitable for sandwich construction of pressure hulls and bulkheads requiring energy absorptive properties.

The prime focus of this work should be chemical modification of existing structural resin systems (designed to enhance energy absorption without reduction of material strength or stiffness).

Phase I: This effort should demonstrate energy absorption in test pieces that maintain the structural material properties of high strength resins. It is desirable to test for energy absorption over the widest possible band of frequencies; however, tests must cover the frequency band from 100 Hz to 4000 Hz.

Phase II: This effort would build on Phase I results by constructing a prototype 21” heavy walled tube, 48” in length with end fittings of closure or mating to similar tubes. The tube would be excited internally and evaluated on the basis of how much acoustic energy it radiated into the water medium and on its structural properties.

Phase III: The contractor would market successful materials to manufacturers of underwater structures. The Navy could be a customer for a limited amount of material for research purposes.

N92-088 TITLE: Low Frequency Spark Gap (Plasma) Transducer

CATEGORY: Exploratory Development

OBJECTIVE: Develop low frequency, High Level, Small Size Transducer based on spark gap technology.

DESCRIPTION: Given the current interest in low frequency sound generation, those systems which cannot allocate the size and weight constraints of traditional low frequency transducer types are in dire need of novel solutions to generating such signature. Therefore, it is necessary to investigate revolutionary methods at generating low

frequency, high-level signals from a relatively small envelope. One such technology that is worthy of renewed consideration due to advances in supporting technologies is the spark gap or Plasma transducer. The application may relate to sonobuoys, countermeasure devices, mobile sources, and laboratory measurement devices or towed or line arrays.

Phase I: Offer a complete transducer system design that would address lowest frequency attainable related source level, efficiency, power requirements and size. Provide a breadboard of the in water spark gap element. Define all high-risk areas.

Phase II: Optimize the spark gap element and provide a prototype of the complete system. Perform in water tests to demonstrate system.

N92-089 TITLE: Solid State Optical Shutter

CATEGORY: Exploratory Development

OBJECTIVE: The primary objective is the development of a broadband, nonpolarizing, and solid-state optical shutter for the protection of optical sensors. The secondary objective is continuously variable optical attenuation of the shutter by means of voltage or current control. The ability to vary optical attenuation would permit the protected sensor to operate with increased dynamic range.

DESCRIPTION: The requirements for the primary objective of the solid-state shutter development are the following. The shutter must operate in the visible to near infrared region of the spectrum with optical blocking capability of 7 orders of magnitude, that is, an attenuation equivalent to an optical density of 7. The device must have a rise time of 10 milliseconds or less with a clear optical aperture of 25 millimeters or greater. It must be optically nonpolarizing with a transmission in the open state of 75% or greater. It must be a tail safe device with the default condition being closed. The device must operate at temperatures between –10C and 50C. Small size is essential: the desired goal for the optical portion is 3 inches in diameter and 1 inch thickness.

The requirements for the secondary objective are the same as the first. Additionally, the optical attenuation of the shutter must be variable from a minimum of 75% transmission to 7 OD or greater. The attenuation should be predictably variable by means of voltage or current control.

Phase I: Devise the concept and design for a solid state optical shutter and conduct a proof of principle laboratory experiment.

Phase II: Development of a working prototype solid-state optical shutter meeting the requirements stated above.

NAVAL CIVIL ENGINEERING LABORATORY

N92-090 TITLE: Impact Mechanism(s) for Seawater Hydraulic Rock Drill

CATEGORY: Exploratory Development

OBJECTIVE: Identify and evaluate an impact mechanism(s) suitable for adaptation to a diver operated seawater hydraulic powered rock drill.

DESCRIPTION: A current model diver-operated seawater hydraulic rock drill uses a single poppet and kicker port to cycle a system consisting of a piston and anvil for providing percussive energy to the drill bit. The performance of this linear impact mechanism, which operates with seawater as the motivating fluid, has proven to be unpredictable and operationally unreliable. A new system is needed, with seawater as the working fluid, which can provide percussive energy necessary for rock drilling while being adaptable to a diver operated tool.

Phase I: Evaluate a candidate impact mechanism(s) for required performance characteristics independent of its incorporation into the rock drill. This shall include design, fabrication, test and evaluation of a prototype impact mechanism(s). Design requirements include an impact frequency of 30-45 impacts per minute with energy of 6-7 foot-pounds. The test plan shall be sufficient to clearly demonstrate the feasibility of the concept and that is suitable for adaptation to a diver-operated seawater hydraulic powered rock drill.

Phase II: Incorporate the successfully demonstrated impact mechanism developed in Phase I into an existing or custom designed rock drill for further performance evaluation. This work shall result in a complete prototype rock drill system which meets specified requirements, including a penetration rate of at least 3.5 inches per minute in 12,000-psi compressive strength rock for a ¾ inch diameter drill bit.

N92-091 TITLE: Trench Cutting in Rock

CATEGORY: Exploratory Development

OBJECTIVE: Investigate, analytically model and demonstrate with laboratory scale physical model tests an innovative concept(s) for cutting trenches in seafloor rock.

DESCRIPTION: Current technology of mechanical rock cutting, such as using silicon carbide abrasives, results in high wear rates, frequent tool bit changes and low traverse speed. The need exists for a method of cutting long trenches one inch wide or larger to depths in excess of six inches in bedrock with a traverse rate of 2 ft/minute or greater. Typical rock that must be cut by the trenching mechanism includes basalt, green schist, and granite. Technologies proposed must be applicable to automated operation while submerged in seawater. Rock cutting concepts must be accomplished with access to one surface of the rock only, and explosive techniques are not acceptable.

Phase I: A detailed report shall be produced which describes the concept and provides sufficient engineering analysis to substantiate its feasibility. Technologies identified must show the potential to be more efficient and effective than current industry practice. A test plan shall also be developed for physically demonstrating the concept in Phase II.

Phase II: Develop, test and evaluate a physical model of the concept(s) identified under Phase I. Model tests shall demonstrate the capability of the proposed system to cut rock while also providing data for determining specific cutting energy and advance rates as a function of power input, trench size and type of material cut. A detailed report of the model test results shall include information required for full-scale development and testing of the proposed concept.

N92-092 TITLE: New Space Configurations for Reverse Osmosis Elements

CATEGORY: Exploratory Development

OBJECTIVE: Develop new space designs for reverse osmosis (RO) spiral wound elements in order to reduce fouling while increasing the ability top periodically clean the elements.

DESCRIPTION: Commercially available RO elements employ a spacer material that separates two membranes to allow feed water to contact the entire membrane surface. There are indications that the current spacer configuration contributes to membrane fouling by forming “dead” areas of low flow behind spacer segments that contact the membrane surface, and are perpendicular to the direction of flow. Commercial users of the RO process provide extensive pretreatment to minimize fouling in their systems. Military RO equipment, however, provides minimal water pretreatment and are required to operate anywhere in the world. The military application therefore requires a spacer material that will accommodate poorer water quality than typical commercial uses.

Phase I: Design several RO element spacer configurations.

Phase II: Fabricate new spacer configurations and compare their effectiveness against current spacer designs in their ability to keep RO elements from fouling, and allow cleaning RO elements once fouled.

N92-093 TITLE: Miniature Navigation System for Divers and Small ROVs

CATEGORY: Exploratory Development

OBJECTIVE: Develop technologies for use in a self-contained system for navigation/positioning of divers and small ROVs.

DESCRIPTION: A current diver navigation method consists of an acoustic range-range system which requires the installation of two reference transmitters and that the diver carry a receiver/processor unit. This system has a Circular Error Probability (CEP) of 3 ft. Applications exist for a small, easy to use navigation/positioning system which could be used either by diver or by attaching it to a small ROV. The system should be completely self-contained and have a CEP of less than 6 ft with a normal magnetic north and the location from which it was initialized.

Phase I: The contractor shall develop and demonstrate the proposed system with proof of concept hardware and analysis. The prototype hardware will not be required to meet the less than 6 ft CEP, nor it be miniaturized, no operable underwater. However, accompanying analysis must show that, with applicable state of the art components, the accuracy requirement could be met.

Phase II: Produce an engineering development model which would operate underwater, but would not be fully miniaturized. Phase II would include testing of the hardware in the ocean, on a range with benchmarks, to verify the accuracy of the system.

N92-094 TITLE: Downhole Propulsion Concept(s)

CATEGORY: Exploratory Development

OBJECTIVE: Develop and analytically model a new concept(s) for providing down whole propulsion in boreholes up to 4 inches in diameter. Validate the proposed concept(s) with laboratory scale component and system tests to determine power requirements, pulling capabilities and advance rates in various sediments.

DESCRIPTION: Downhole propulsion may be described as a process in which an automated mechanism pulls a pipe or cable through a borehole while simultaneously providing a method to develop the reaction forces necessary for forward advancement, such as by champing against the wall of the borehole. The process would be used in conjunction with a downhole drilling mechanism such as that used for oil drilling or in coiled tubing drilling rigs. A need exists for a downhole propulsion system to pull lengths in excess of 10,000 feet of steel pipe or cable up to 4 inches in diameter through various types of consolidated soils and bedrock, while either eliminating or providing sufficient force to overcome the friction of moving the pipe/cable through the borehole. Electrical or hydraulic power for operating the downhole propulsion system could be provided from the surface drilling rig; however, novel powering methods may be included in the overall concept(s).

Phase I: A detailed report shall be produced, including a full description of the concept(s), operational principles involved and new technology proposed, as well as substantiating model analysis. A component and system test plan for providing parametric data with which to evaluate the concept shall also be included. Pulling and reaction forces developed, advance rates in various borehole materials and power requirements of the system are specific items to be quantified in the engineering analysis and proposed testing.

Phase II: Develop, test, and evaluate a laboratory scale model of the downhole propulsion system identified under Phase I. The model shall demonstrate the capability of the system to pull pipe up to 4 inches in diameter through a borehole in various sediments. The data collected shall also be used to determine power requirements for various downhole pulling situations.

NAVAL WEAPONS SUPPORT CENTER

N92-095 TITLE: Qualification of Reclaimed Explosives

CATEGORY: Exploratory Development

OBJECTIVE: To determine if reclaimed explosives or explosive ingredients can be requalified for new weapons systems.

DESCRIPTION: See Phases I and II below:

Phase I: Conduct literature search into available technology to reclaim explosives from military munitions for subsequent reuse in new weapons systems. Explore sources of explosives and possible reclamation technology. Select reclaimed explosives or explosive ingredients from two or three sources to determine if material meets military specification for end use from both a chemical/physical properties and performance standpoint. Also verify material is safe to handle, process and transport. If material does not meet specifications, identify potential reprocessing procedures to bring material up to specification. Provide recommendations for Phase II evaluations.

Phase II: Perform lab scale studies to reprocess explosives to meet specification requirements. Perform bench/prototype evaluations to validate that reclaimed and reblended explosives meet chemical/physical properties and performance criteria established for weapons systems. Perform insensitive munitions testing on material if required for qualification of end item. Perform system evaluation to verify reclaimed explosive handling/reprocessing operations meet safety and environmental standards.

N92-096 TITLE: Polymer and/or Metal Matrix Composite Materials for Thermal Management of Electronic Devices

CATEGORY: Exploratory Development

OBJECTIVE: Improve thermal performance of Standard Electronic Modules (SEMs). Investigate the use of high modulus continuous graphite.

DESCRIPTION: Investigate the use of high modulus continuous graphite fibers in a polymer and/or metal matrix composites in irregular shapes other than flat plates. One shape to be considered is Standard Electronic Module (SEM) Format D Heat sink. Other shapes may include varying thickness plates. Factors to consider may be thermal conductivity, coefficient of thermal expansion, density, and protective finishes.

Phase I: Representative samples of irregular shapes may have been used in Phase I.

Phase II: Phase II work should work towards fabrication and evaluation of actual SEM heat sinks.

NAVAL OCEAN SYSTEM CENTER

N92-097 TITLE: Protective Coatings for Containment of Liquid Metal Combustion

CATEGORY: Advanced Development

OBJECTIVE: To develop a coating process to protect metal parts used in liquid metal combustors from the effects of high temperature and hot corrosion. The goal is to extend the operating range and survivability of these parts used in advanced underwater vehicles powered by liquid metal combustion.

DESCRIPTION: The Navy is developing liquid metal combustion as the power source for the propulsion systems of several advanced underwater vehicles. Parts made from Hastelloy alloys are used in containment of the liquid metal reaction. Demonstrate refractory metal and/or ceramic coatings on Hastelloy Substrates which protect the substrate from attack by liquid lithium at temperatures of 2000-3000 F.

Phase I: Optimize the coating process(as) to obtain the best performance, and parts coated for testing according to specifications provided by the Contracting Officer.

Phase II: Provide a breadboard demonstration.

DAVID TAYLOR RESEARCH CENTER

N92-098 TITLE: Liquid Metal Wetted Flexible Metallic Brushes for Current Collectors

CATEGORY: Research

OBJECTIVE: To develop liquid metal wetted flexible metallic brushes for current collectors

DESCRIPTION: The development of flexible metallic fiber wetted brushes will result in their use in liquid metal current collectors for transporting large currents in homopolar machinery for superconducting electric drive systems for Naval ships. The Electrical System Division of the David Taylor Research Center (DTRC) requires the development of advanced technology for flexible liquid metal wetted metallic fiber brushes or finger brushes for direct current homopolar machinery for the electric drive program. These fiber brushes together with the liquid metal will transport large currents in the current collector for long durations of time.

Phase I: Will involve research in development of new metallic fiber brush technology and concepts.

Phase II: Involve continuation of development of new types of brushes, methods of manufacturing and testing the brushes under high current loads. The brushes will be tested in conjunction with DTRC. One of the major development problems is obtaining easily changeable and maintainable brushes for machinery. The exact requirements for the fiber brushes will be supplied to the contractor by DTRC after award of contract.

N92-099 TITLE: Development of Adaptive Multigrid Methods for Application to Steady and Time Dependent 3D Reynolds-Averaged Navier-Stokes Sovlers (RANS)

CATEGORY: Research

OBJECTIVE: Development of Adaptive Multigrid Methods for Application to Steady and Time Dependent 2D Reynolds-Averaged Navier-Stokes Solvers (RANS).

DESCRIPTION: An accurate and fast method for evaluating new naval ship designs, submarines in particular, with the predictive capability necessary to quantitatively rate the viscous vertical flows associated with a new hull/appendage/propulsor arrangement is required. This tool will be an integral part of the development of the capability to rapidly iterate new designs, in days instead of months and will provide the means to assess the various vertical flow effects associated with a particular hull/appendage/propulsor arrangement. Specifically an efficient adaptive multigrid method will reduce problem setup time from weeks to hours and computer processing time from days to minutes.

Phase I: Adaptive multigrid algorithms will be developed in two stages: Local grid refinement is to be achieved by relating the grid distribution adaptation to the location of rapid changes in the flow fields which will be provided as input data from a separate RANS analysis. IB: Working closely with David Taylor Research Center (DTRC) the local grid refinement process will be integrated with an existing multigrid RANS code in such a way as to permit dynamic grid refinement concurrent with each time step of the RANS solution. Deliverables are 1. Fortran source

code 2. Assistance in the integration effort and a report describing effectiveness of the method and a detailed description of the process.

Phase II: The adaptive flow solver will be modified to provide best computational efficiency and accuracy when coupled with the various multigrid iteration sequences. As a minimum V cycle and W cycle multigrid sequences will be evaluated. The accuracy and computational efficiencies will be demonstrated when supporting the multi-million cell grid structures necessary to analyze the vertical flows created a by a fully appended submarine. The criteria for accuracy will be the adaptive multigrid flow solver to provide the needed resolution of vorticity strength. Deliverables are adaptive multigrid flow solver source code fully integrated with an appropriate DTRC RANS code and a report describing the algorithms used and an evaluation of computational accuracy and run time performance.

N92-100 TITLE: Investigation of the Hydrodynamic Lateral and Vertical Forces and Pitching and Yawing Moments Developed on a Submerged Vehicle with a Ducted Propulsor

CATEGORY: Research

OBJECTIVE: Develop a theoretical method for predicting the hydrodynamic forces on a submerged vehicle with a ducted propulsor at an angle of attack.

DESCRIPTION: There is a need for an accurate method for evaluating new designs of submerged vehicles which are propelled with ducted propulsors. Experimental data indicates that there are large hydrodynamic lateral and vertical forces and pitching and yawing moments that are developed on the ducted propulsor when the submerged vehicle is maneuvering. In addition the ducted propulsor induces hydrodynamic forces on the after body and the control surfaces in the vicinity of the propulsor. These forces and moments must be calculated in order to evaluate the stability, control, and maneuvering characteristics of the submerged vehicle. There are theoretical and semi-empirical methods for calculating the hydrodynamic forces and moments developed on the hull and appendages for a submerged vehicle with a conventional open propeller. However, there are only approximate empirical methods for calculating the forces developed on ducted propulsors, and these empirical methods are based on a limited experimental data base. The tool that will be developed is to be an integral part of a computer code which will be used to make rapid iterations on candidate new designs for submerged vehicles.

Phase I: A theory will be developed for predicting the hydrodynamic lateral and vertical forces and pitching and yawing moments developed on a submerged vehicle with a ducted propulsor. The theory will predict the effect of an angle of attack on the convection of the boundary layer over the after body from the windward side of the hull to the leeward side, and the effect this has on the inflow velocity into the duct. The theory will predict the hydrodynamic forces developed on the propulsor and the forces induced by the propulsor on the hull and appendages in the vicinity of the propulsor for relatively small angles of attack. The investigator will prepare and issue a technical report that will clearly describe the physics of the flow around and through the duct and the theory for predicting the hydrodynamic forces and moments that are developed. The report will also compare the results of the calculations using the theory with appropriate experimental data.

Phase II: The theory will be upgraded, if necessary, based on the results of the comparison performed in Phase I. It will then be extended to predict the effect of relatively small pitching and yawing angular velocities. Calculations will be performed with the extended theory and the results will be compared with available experimental data. If the agreement between the theory and the experiments is satisfactory, the method will be upgraded to account for combined large angles of attack and pitching angular velocities or combined angles of drift and yawing angular velocities on the hydrodynamic forces and moments. It will also be extended to predict the effect of over and under propulsion on the effectiveness of the stern control surfaces and the forces and moments due to angle of attack, angle of drift, pitching angular velocity, and yawing angular velocity. A technical report will provide the theory and the results of calculations comparing the theory with appropriate data.

NAVAL SEA SYSTEMS COMMAND SUPPLEMENT

N92-101 TITLE: Development of Naval Ship Producibility Lessons Learned Database

CATEGORY: Advanced Development

OBJECTIVE: To develop a lessons learned database for Naval ship producibility.

DESCRIPTION: Frequently, previous design history, both good and bad is difficult or impossible to obtain in a timely fashion. This can result in designs mistakes being repeated or design improvements being lost or implemented only intermittently. This project is the development and population of an interactive database for documenting and tracking lessons learned regarding issues of design for producibility. This database should provide a means to document and track design decisions, the rationale behind those decisions, the political environment in which those decisions were made, and the expected benefit of that decision. The database must then allow for the tracking of feedback from the production facilities relating the impact of that decision to their efforts. Finally, there should be provisions in the database for a short lessons learned review highlighting pertinent key points such as man-hours savings or cost, and unique conditions relative to the item. All of these sections should be wrapped in a tracking effort is incorporate this information with the ship design database, providing online access to both design and design decision information.

Phase I: Develop the database object-role relationships using Information Analysis Method techniques. Develop a proof of concept database using the NAVSEA CAD 2 System relational database software.

Phase II: Develop system queries and populate the database.

N92-102 TITLE: Management Decision Making Data Base

CATEGORY: Exploratory Development

OBJECTIVE: To identify key parameters in program management decision making a devise a means for collecting, structuring and analyzing decision making data.

DESCRIPTION: Program managers face a variety of difficult decision tradeoffs concerning resource allocation to meet program objectives. Decisions that involve budget control, personnel levels, schedule deadlines and work quality often carry unforeseen, long term tradeoffs. A management decision making database would allow managers to test their own decision alternatives against the past experience of many managers to determine what, if any, longer term issues they may need to factor into their current decision making processes. The ready availability of a means to examine potential longer term consequences of immediate actions should help managers control program costs.

Phase I: The offeror will develop a methodology for database development and will demonstrate its applications and validity by collecting, structuring and analyzing data for several test cases.

Phase II: The offeror will refine the methodology through further applications, complete the collection of a sufficient database, package the results as an easy to use desktop software program and provide necessary instructional support in its use.

N92-103 TITLE: Shipyard Productivity Measurement

CATEGORY: Exploratory Development

OBJECTIVE: To design and develop a simple method that allows yard foreman and crew leaders to measure and report their own productivity in accomplishing a variety of shipbuilding tasks.

DESCRIPTION: Enhancement of shipyard labor productivity in construction, repair and re-outfitting is needed. A participatory measurement methodology that fosters cooperation between labor and management is desired. The methodology must provide: feedback to crews concerning their productivity, information to management concerning

obstacles crews encounter in performing work, ease of data entry and reporting, and direction for continuing productivity improvement.

Phase I: The offer will provide a description of the proposed measurement system including details of how individuals using the system will record data and use reported information.

Phase II: The offeror will implement and test the measurement system on an experimental basis at a site to be designated.

N92-104 TITLE: Life Cycle Cost Models for Naval Ship Design

CATEGORY: Exploratory Development

OBJECTIVE: To develop tools to make engineering decisions based on life cycle implications.

DESCRIPTION: These engineering decision tools would include methods to quantify the cost impacts of producibility candidates in order to conduct trade-off analysis. The development of these models will also include consideration for training for ships force, maintenance activities and other life cycle factors incurred during the operational phase of a ship.

Phase I: Explore approaches for the development of engineering tools to aid in the decision making process. Propose modifications of ship acquisition basic construction cost estimating models and processes so that they apply more realistic parameters which drive cost.

Phase II: Develop improved cost estimating tools to encompass producibility and life cycle maintenance considerations based on the present state of the art for in process ship design.

Phase III: Develop procedures and/or algorithms to project cost for life cycle operation and determine real cost effective design parameters for future use.

N92-105 TITLE: Analysis of Strategic Technologies

CATEGORY: Exploratory Development

OBJECTIVE: To develop a methodology for analyzing strategic defense industrial technologies for the purpose of designing appropriate policies to encourage their development.

DESCRIPTION: Strategic technologies exist within many defense industries. The rate of technological advancement and innovation depends upon many factors, including generation of new ideas, problem solving ability, labor force skills and market forces. These factors (and others) combine to accelerate progress in some technologies and impede progress in others. A method for collecting, structuring and analyzing industrial data is needed so as to discover how to increase the competitiveness of strategic technologies.

Phase I: The offeror will provide a description of the proposed analytical methodology, explain how it would be used to address the problem of technological competitiveness, and demonstrate a prototype application of the method.

Phase II: The offeror will complete the development of the methodology, apply it to a wide range of strategic technologies and show how the results can impact policy design.

N92-106 TITLE: Modeling Naval Ship Construction Delays

CATEGORY: Exploratory Development

OBJECTIVE: To design and demonstrate a simulation model that can be used to quantify the cost of shipyard construction delays.

DESCRIPTION: Delays during ship construction add unnecessary costs. A simulation model of the ship construction process should allow program managers to understand the primary causes of delays, quantify their impact on ship cost and schedule, explore tradeoffs among cost, schedule and performance, and assist in supporting management decision-making. The model should include feedback linkages can create costly disruptions in the work progress.

Phase I: The offeror will provide a description of the model and demonstrate its ability to help analyze ship construction delays.

Phase II: The offeror will refine the model, provide the necessary data interfaces and apply the model to a number of past and current shipbuilding projects to demonstrate model validity.